JUN 20 1927

Telephone Engineer

VOL. 31, No. 5 CHICAGO

STROWGER AUTOMATIC

Service Unexcelled

STROWGER Automatic telephone equipment leads the world in speed, accuracy and uniformity of service.

Strowger equipment combines the universally recognized advantages of mechanical operation with the reliability of performance that is characteristic of the simple and tried Strowger mechanism.

Telephone companies and administrations that value Good Will need go no further than the Strowger system for the Good Service that brings it.

Automatic Electric Inc.

Factory and General Offices: 1033 West Van Buren St.
Chicago, U. S. A.

TELEPHONE EQUIPMENT

MAY, 1927

TERMITE-PROOF

UNTREATED POLES don't last long when *termites* begin to get in their dirty work—for not only do these insects, by their burrowing, steal from the bearing strength of untreated poles, but they form numerous channels through which decay-causing fungi can enter and spread.

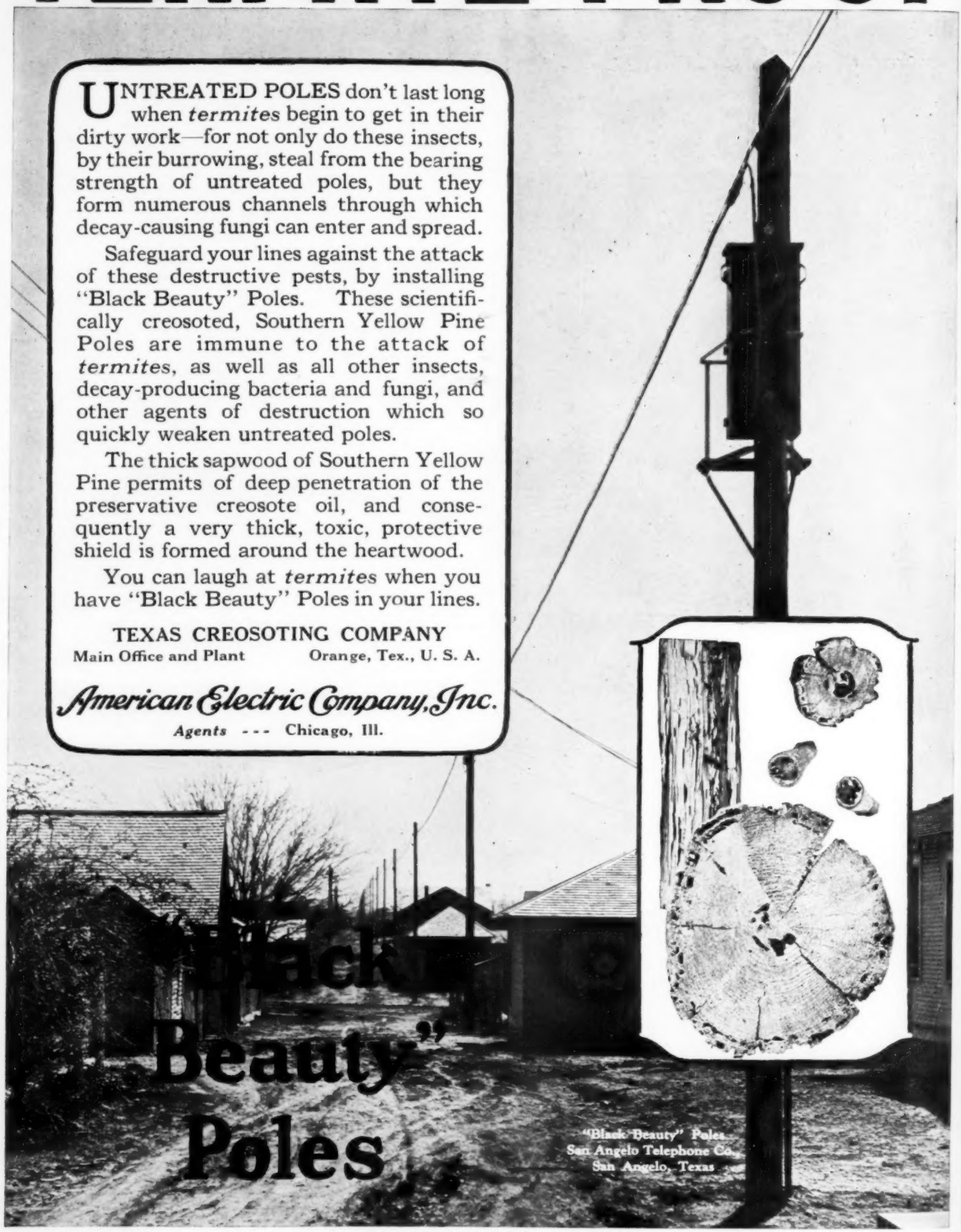
Safeguard your lines against the attack of these destructive pests, by installing "Black Beauty" Poles. These scientifically creosoted, Southern Yellow Pine Poles are immune to the attack of *termites*, as well as all other insects, decay-producing bacteria and fungi, and other agents of destruction which so quickly weaken untreated poles.

The thick sapwood of Southern Yellow Pine permits of deep penetration of the preservative creosote oil, and consequently a very thick, toxic, protective shield is formed around the heartwood.

You can laugh at *termites* when you have "Black Beauty" Poles in your lines.

TEXAS CREOSOTING COMPANY
Main Office and Plant Orange, Tex., U. S. A.

American Electric Company, Inc.
Agents --- Chicago, Ill.



TELEPHONE ENGINEER, May, 1927. Volume 31. No. 5. Published monthly by TELEPHONE ENGINEER. Publication Office, 236 N. Clark St., Chicago, Ill. Subscription price $2 a year in the U. S. Entered as second class matter June 6, 1922, at the Post Office at Chicago, Ill., under act of March 3, 1879.

Telephone Engineer

Volume 31 MAY, 1927 Number 5

Check Up on Accounting Methods as Starter

With the perennial question of depreciation again before the industry in connection with the recent order of the Interstate Commerce Commission, the necessity of checking up on past practices and adjustment to new conditions arises. Depreciation is essentially a practical problem. Plant elements rust, decay and wear out and provision must be made for their retirement when and as replacement becomes necessary.

Since the provision for the ultimate retirement of a plant element must be begun at the instant the element is placed in service and since no one can predict exactly the term of years that will pass before retirement is necessary, this provision can only be made on the basis of an estimate of the probable years of service. The only basis for such an estimate is the experience with similar elements in the past, modified by judgment as to any changes in conditions that the future may bring.

The difficulty of arriving at accurate estimates arises to some extent from the consideration of the experience with individual or small groups of elements and the application of this experience to larger groups. For example, a plant man may estimate the life of telephone poles at twenty years and may be able to point to many examples of poles that have lasted that long. This does not prove, however, that the average life of a pole or, what is more important from an accounting standpoint, the average life of a dollar invested in poles, is twenty years.

The time will come when we will find it necessary to supply a more substantial basis for our estimates of life of plant than we now have available. It is extremely doubtful if more than a few plants could justify from actual figures over a long period of years, even the modest depreciation rates that are being used and yet experience has shown that the rates are not excessive and in some cases are actually inadequate.

In some actual cases, the accumulation of the credits to the plant accounts over a period of years by reason of retirements of plant elements, indicate average life in excess of what is known to be the case. This is due either to the failure to credit the plant account when the element is retired or to the use of an estimated original cost which is inadequate. As a result the credits to plant accounts and the charges to depreciation reserve are both too small and the reserve continues to increase on the books from year to year in spite of a low rate of depreciation.

The remedy is to be found in the use of a proper system of reports of plant removed and time spent in removal and in the use in making credits on the books of proper unit costs. Fortunately, the method of providing such a system of reports and of determining the unit costs is available through the work of the accounting division of the United States Independent Telephone Association. It is worth while, when the entire matter of depreciation is under consideration, for each company to check up on its practice, and if it is found to be out of line with recognized procedure, to revise its methods and get started on the right path.

Bell No Santa Claus for Promoters

In discussing relations between the Bell and Independent groups in the telephone industry, President F. B. MacKinnon of the United States Independent Telephone Association at the Ohio convention, stated that the relations in the matter of purchase and sale of telephone properties between the two groups were now in a more satisfactory state than ever before. From the published statements of policy of the Independent Association this may be interpreted to mean that Bell purchases of Independent properties will only be made when this is clearly the best solution of the problem of giving service in the locality affected. It certainly must mean that the Bell system is not in the market to buy any property that may be offered to it.

In the old days of building competitive telephone systems, the promoters often went ahead on the assumption that the competing plant could be sold

to the Bell if it did not prove to be a financial success and their plans worked out in many cases, due, largely, perhaps, to the policy expressed by Theodore N. Vail that no one who invested money in good faith in telephone property should be compelled to suffer a loss.

That such an outcome may be expected in case of some of the present day promotions is not to be expected. It is not likely that the Bell companies would undertake to cover losses to promoters who place excessive security issues on properties purchased at high prices and which fail to produce the expected returns. The present activity in purchase and sale of telephone property can not continue indefinitely and when the slack period comes the owners will find that they have properties which they will have to operate for a long period in the future.

This will not affect telephone men who have purchased property for the purpose of operation and who expect to make their profit in the long pull rather than on a quick turn-over. These men will arrange their affairs with a view of continuing the operation of the properties for an indefinite period. If there are others who have entered the field with the idea that they can sell to the Bell at any time, it is extremely likely that they will be disappointed and some of them may find that they are in the telephone business for much longer periods than they have anticipated.

Salesmanship a Factor in Routine

A few years ago, in one of the larger telephone companies, there were two district plant chiefs in adjacent districts located somewhat remotely from the general operating headquarters. Both had been in their districts for several years and the condition of the plants in their respective districts was a fair reflection of the results achieved by each.

One of these plant chiefs seemed to be much more fortunate than the other in getting approval and action from the general headquarters on his recommendations for extensions and reconstruction and the plant in the district bore evidence of this fact. The less fortunate man attributed the condition to some sort of a superior stand-in with the powers that be.

On one occasion he took the opportunity to mention the fact to his brother plant chief and he then learned the secret of the latter's greater success in getting his projects completed. The explanation was simple when the facts were brought out. The second plant chief explained that he never sent in a recommendation without data to justify the work being done. If he recommended work on account of excessive trouble, he had the wire chief in the area affected prepare figures as to the number of cases of trouble, the hours of lost service to subscribers, etc. Many times, snapshots of the conditions accompanied his report. Similarly, his other recommendations were backed by supporting data and suggestions as to the manner of doing the work.

His reports and recommendations had a character which compelled attention by his superintendent and the engineering forces of the company while the colorless reports in general terms made by his neighbor received only routine consideration. The difference was largely a matter of salesmanship which may be important even in routine matters of strictly intra-company business.

Europe Approaches Toll Speed Benefits

A recent foreign news item referred to the completion of a new long distance cable between Paris and Strassbourg, a distance of 494 kilometers, or about 300 miles and among other things said that the time for completion of telephone calls between these points would be reduced from five hours to fifteen minutes.

While this would not be regarded as particularly fast service in this country for a similar distance which is comparable to the distance between Chicago and Saint Louis, it is a decided improvement over the past and indicates that European administrations are awakening to the fact that the demand is for more rapid service.

The experience of European systems will undoubtedly be the same as those in America, that a reduction in time of completion of calls results in marked increases in the amount of traffic offered, and, unless the inertia of government operated agencies prevent, it is likely that European standards of service will gradually approach those with which we are familiar.

What Do You Get from the Meetings?

The convention season is in full swing now and most of the meetings this spring have shown by attendance figures that the industry puts a high rating on these opportunities to get together and talk things over.

Set programs and the informal sessions that are held "when good fellows get together" give every man the best chance of the year for comparing notes with his brothers-in-arms and to take an appraisal of his own methods by means of these comparisons. But the telephone man who goes to these affairs simply as a matter of routine, without returning determined to put his convention inspiration into work, might just as well save the time and money of his company. Conventions, with all the good they do, are not capable of supplying the actual working power to the job whose solution is learned at these events. The conventions furnish lots of sparks but you have to supply the fuel if you're going to get anything worth while from the conventions.

Measured Service Adopted at Everett, Wash.

By MANDUS E. BRIDSTON

After several months experimentation and actual operation since January 1st, the Puget Sound Telephone company of Everett, Washington, now is in position to draw some conclusions as to the practicability and economy of the new system of metered service in use in its plant.

This system employs the Telechronometer, the invention of Maj. Garrison Babcock, a device which records the time units on outgoing calls on a "pay-for-what-is-used" basis.

Some of the outstanding results noted to date are: Increase of 1,500 new subscribers as compared to 239 new installations in 1926; an increase of 22 per cent in the amount paid by 25 per cent of the telephone patrons and an average decrease of 27 per cent for 75 per cent of the subscribers; a saving of about $238,000 in urgent extensions due to the increased use of multi-party lines.

The system was first tried out in Everett four years ago, but due to various reasons including minor imperfections in the measuring device, it was discontinued. Since that time improvements have been made and when the various devices were favorably passed upon by Dean C. E. Magnusson of the college of Engineering of the University of Washington, the state department of public works permitted its adoption in Everett.

The mechanical features and engineering problems involved in the use of the telechronometer will be dealt with in the present paper.

For the purposes of recording the ringing and conversation time of all outgoing calls, which is registered on the Telechronometer in a cumulative manner, each minute has been subdivided into four units each, called "telos." Four telos are termed a "telechrone." A message is measured in 15-second units or multiples thereof. Thus, a message may commence during the last few seconds of the first unit and end during the first seconds of the last unit and both of these units will be charged as well as the intervening units.

The meter, having two movements known as the "positive" and the "negative," responds to time controlled voice current polarity changers located in the telephone central office connected with the switchboard call answering equipment.

As the normal line current is of fixed polarity, the meter registration of the last unit of the preceding message when "negative" will occur either when the telephone is again used for outgoing service or when responding to a call from another station.

The meter is absolutely controlled by the action of the removal of the receiver in making a call and at the end of the conversation the replacement of the receiver cuts out the meter and in this cut out condition no use by other subscribers on the same line, or the telephone company's representatives working on subscribers' lines will cause registration, as the subscriber absolutely controls the meter.

In all telephone exchange systems—manual, automatic (dial) and semi-automatic (operator supplies individual requirements in each call but machine system performs all common functions, involving completed connections), the switchboards have one common feature, namely: separated battery supply is accomplished by either one of the two recognized systems known as the impedence coil feed and the repeating coil feed. In the impedence coil feed the telephonic communication between subscribers passes through condensers which freely pass voice currents but arrest the flow of uninterrupted battery current. In the repeating coil type of connecting link the coils are wound upon a common magnetic core, and the battery is connected to supply the two ends of the connecting link separately, thus providing independent signal and control circuits but giving free path for voice currents through the magnetic core by a process of induction.

In the metering system such as the Telechronometer, it is necessary that the subscriber originating the call shall pay for the service, and therefore the common practice involved in telephone switchboards whereby the battery feed for voice transmission being separated becomes of vital importance To accomplish the automatic method whereby the originating party to a call shall incur the meter charge therefor, it is only necessary to isolate the battery feed to all of the so-called answering side of the connecting links and in this isolated circuit place the Telechronometer actuator known as the pole changer. With this arrangement the subscribers' meters are responsive to the time controlled current change as soon as the call is answered by either the operator of the automatic connecting equipment while the calling end of such connecting links, having their battery supply for voice current transmission connected direct to the battery will not influence any operation in the called party's meter.

Where "reversed" charges are involved, it is a transaction between subscribers and if the called party wishes to pay for the service, it is accomplished by advising the calling party to hang up the receiver and the called party will then proceed to originate the call in the "reverse" direction.

Central Office Equipment

The central office pole changer comprises a standard pendulum clock provided with quarter minute make and break contactors connected through suitable current amplifying relays to valve control solenoids arranged to control the flow and exhaust of air compression in two cylinders having pistons attached by a yoke with adjustment thrusting upon two carbon pile rheostats each. These four rheostats are electrically connected to the battery source and the battery supply circuits feeding the answering end of the switchboard connecting links by what is known as the "Wheatstone Bridge" circuit.

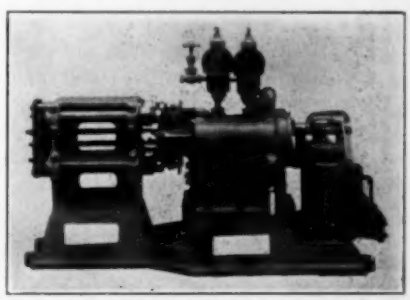


Fig. 1—Pole changer equipment used in connection with metered service, Puget Sound

The function of the time controlled valve is to simultaneously exhaust one, thereby relieving pressure on the two sides of the Wheatstone Bridge rheostats and applying pressure to the other cylinder thrusting upon the other two Wheatstone Bridge rheostats, the electrical effect of which is to reverse the polarity in the battery feed to the answering end of the switchboard connecting links, connecting with this time controlled source of current.

By the method described, it will be observed that a reversal of polarity is accomplished every 15 seconds, and, through the method employed, namely—carbon pile rheostats, by a simultaneous relief on one pair of rheostats and compression upon the other, the change in polarity is accomplished with great rapidity and with a minimum disturbance in the telephone battery supply to the answering side of

the connecting links, owing to the fact that the carbon pile rheostats change under pressure of perfect gradation. (For diagramatic illustration, see Schematic Circuit, Fig. 2.)

The design of the Wheatstone Bridge rheostats and the time controlled valve

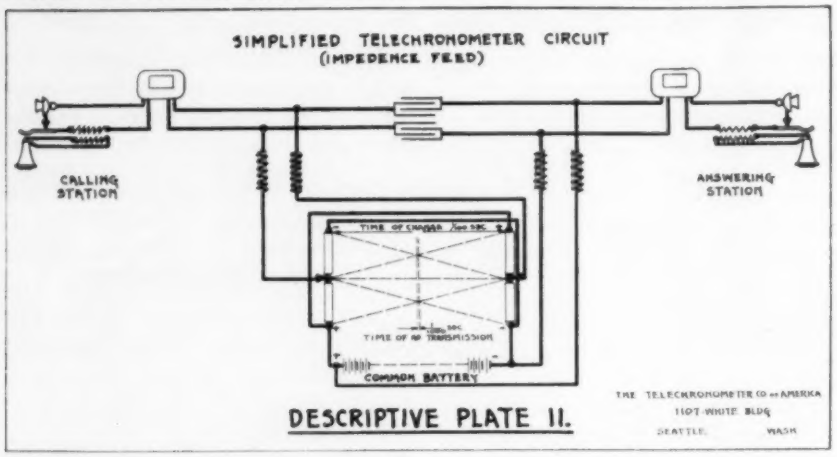


Fig. 2

compressor which is shown in Fig. 3 follows closely the conventional designs which have proven successful in other arts, such as electric clock systems, time controlled electric circuits and air compressors, but adapted to the particular requirements of the telephone service.

The carbon pile rheostats are of a construction thoroughly proven in practical use in electrical controlled circuits, and are of current carrying capacity sufficient for the entire load of any sized exchange.

The current required in each answering end of the telephone connecting link varies from thirty to one hundred milliamperes, the average approximately seventy milli-amperes per connection in use.

The installation consists of duplicate equipment throughout with suitable interconnecting switching panels enabling convenience in maintenance and continuous operating service.

The standard time clocks are provided with suitable provision for an official seal under the control of the rate regulatory body.

Subscribers' Station Equipment

The Telechronometer sub-station meter, Fig. 4, consists of an iron armored enclosure supporting a mounting plate upon which is mounted a conventional form or dials with pointers geared to a driving ratchet and arranged to record in one cycle 40,000 units of measurement of 15 seconds each or 10,000 minutes of registered conversation.

On the back of the mounting plate, Fig. 4, is fastened a two-coil motor magnet of six and five-tenths ohms and two hundred eighty-eight turns, the terminals of which are suitably insulated and carried to terminal block, through which coils both sides of the telephone circuit are carried in the conventional form.

Associated by pivot mounting in conjunction with the two coils is a permanent magnet with suitable pole-pieces arranged to be influenced in a rocking motion by the polarity of current flowing through the said coils. Upon the spider which pivotly supports the permanent magnet, there are arranged two reciprocating ratchet dogs, associated with a ratchet wheel geared to the dial pointer gears of the register.

The motion of the permanent magnet

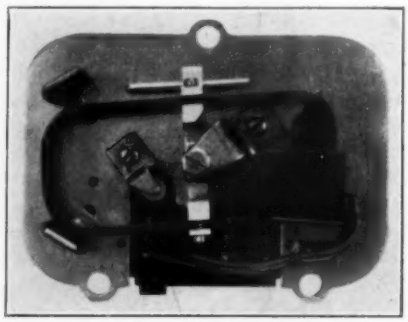


Fig. 4—Telechronometer metering service for subscribers at Everett, Wash.

actuated by the time controlled current flowing through the coils transmits the movement to the reciprocating ratchet dogs whereby the 15-second changes of polarity are transmitted in corresponding units of measurement in progressive motion to the dial pointers, three in number suitably geared to the register in "telechrones." These dial faces are serial, indicating tens, hundreds, thousands, telechrones.

The reciprocating dog actuation prevents any backward motion of the dial pointers, and any rocking motion of the permanent magnet transmits a progressive action to the dial pointers.

The movement of the permanent magnet is held in limits which give one and one-third tooth movements to the reciprocating dogs which is approximately a movement of 15 degrees in either direction.

The permanent magnet is of such weight and design as to be responsive in its movement to changes in polarity up to one and one-half cycles per second, thereby preventing the meter from responsive action when subjected to the lowest frequency ringing current used for signalling purposes, which might otherwise occur if the receiver of a substation is removed while the ringing current is passing over the subscribers' line.

The pivotal mounting of the permanent magnet is placed below its center of gravity, thereby causing the permanent magnet to become in action a form of inverted pendulum. This over balance gives a determined position to the moving element of the meter and has a gravity value of twenty grains, the effect of which is to stabilize the meter making it responsive only to the time control pole changer in the central office.

The pivot bearings of the Telechronometer are constructed of "Delhi" steel suitably hardened and polished and provides the meter with guarantee against rust or corrosion. The steel magnet is held in position by a non-corrosive spider and the surface of the magnet is coated with cellulose enamel protecting it against moisture.

The remaining piece-parts of the meter

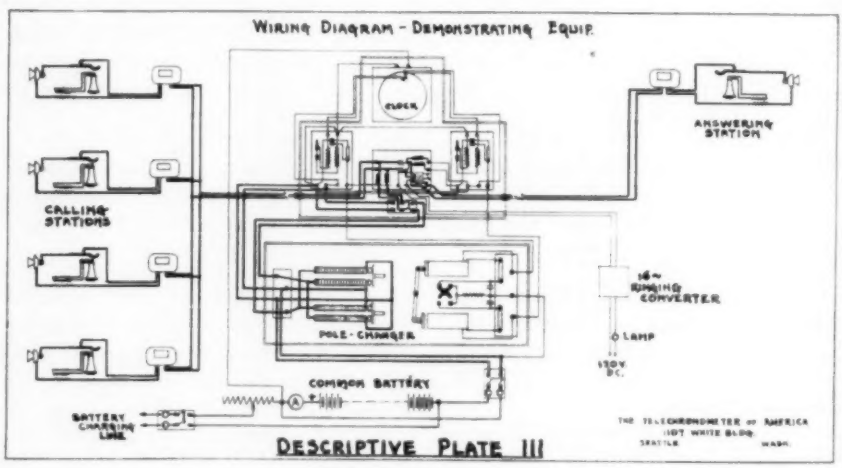


Fig. 3

are of brass and aluminum excepting mounting plates and metal case which are of cold-rolled steel, the former being

heavily nickeled; the latter being coated with cellulose enamel as a protection against moisture.

The meter is supported by three legs which sustain the back of the case and the mounting plate. After fastening the

Fig. 5—Telechromometer subscriber installation

meter in position for installation by inserting mounting screws into the hollow legs the front cover is attached by a loose hinge and with a machine screw set firmly in place, after which a seal wire is inserted through a hole provided for that purpose in the cover closing screw.

The front cover with a plate glass window, secures the mechanism of the meter including the heads of the mounting screws suitably protecting the meter against accumulation of dust within its works as well as any manipulation through removal of its mounting screws.

The lead-in wires to the meter are carried through suitable bakelite conduits to the terminal plate and any manipulation of the meter or dial gears through these conduits is prevented by installation of a baffle plate below the dial gears.

The purpose of a two-coil design is to provide a motor mechanism which will carry current from both sides of a subscriber's line, either side of which will normally operate the meter, guaranteeing operation regardless of shunts through ground or other paths in the telephone circuit so long as the instrument is operative for commercial telephone service.

The above described metered service system with its pole changer equipment in the central office, and meter in connection with the receiving equipment is adaptable to any existing telephone exchange, and its electrical and mechanical requirements involve no greater skill than that now required in the operation of any of the telephone exchange systems now in use. Its service requirements in the matter of personal attention is so slight that no additional personnel is necessary.

Iowa Sets Danger Signal On Questionable Financing

Des Moines, Ia."Stop, look and listen" on the financing being done in connection with many telephone company sales and mergers these days. That was the warning coming out of the Iowa Independent Telephone Association's thirty-second annual convention held here April 19-21. The association adopted a resolution counseling a very thorough "investigate before you invest" policy and made plans to get plenty of publicity through newspapers and banks in the state for the warning.

The association re-elected all of its officers, headed by F. G. Moore of Washington. Charles R. Hurmence, Sumner, was returned to the vice-presidency and Charles C. Deering was re-elected secretary-treasurer.

An attendance of approximately 350 of the state's telephone men, operators, and exhibitors had checked in when the business end of the program was opened with a skit on operating methods of the various periods in telephone history.

Thorne Brown, former chairman of the Nebraska commission, spoke on the current problems in the telephone business and stressed the matter of getting rates profitable to the company but not "all the traffic would bear." He failed to see much hope for many of the small companies with 100 or 200 subscribers, saying that they have donated too much service to allow them to get by. He also advised that the telephone companies pay more attention to prompt collections.

E. D. Glandon, Pittsfield, Ill., spoke on "Radio Service, a Revenue Producer." He described the Pittsfield installations and operation and told of how the American Program Service Association is functioning. There are plenty of reasons for going slow with the service, Mr. Glandon stated, among them being the fact that the business is in an evolutionary stage. Following the lively discussion on the Glandon talk, H. T. McCaig, assistant Chicago manager for Stromberg-Carlson spoke on program service at St. Paul, describing the apparatus used. He also forecast a national program service organization that would contract with local companies for relaying its programs to subscribers.

Small Company Worries

Finances constitute the main problem confronting the smaller companies today, in the opinion of J. C. Crowley, secretary of the Minnesota Telephone Association. In getting the rates that will help them out of their miseries the small companies are handicapped by their inadequate records, he stated. He cited plenty of specific cases where proper records would have helped telephone companies in pointing out their deficiencies and correcting them. Crowley quoted a Minnesota manager on the problem raised by the necessity of re-building plant with construction and material costs much higher than when the plant was originally installed.

President MacKinnon of the national Independent association told what the association was doing in trying to put a check on unwise mergers, sales and financing, and said the prospects for many of the companies recently merged or purchased were rather gloomy so far as getting a profit that would warrant the financing was concerned.

He also told of the work the national association is doing with the Interstate Commerce commission relative to the depreciation order and said that the association expects to have the problem, as far as the commission is concerned, narrowed down to 200 companies.

J. M. Plaister addressed the convention on the effect on the industry of the unusual activities, sales and mergers which have taken place. In telling of the sections into which development of telephone business has been divided he expressed the opinion that the industry is on the verge of a fight for actual control of the groups voluntarily formed when the companies began getting together. He mentioned the lack of a state commission in Iowa as exposing the state to peril from promoters "on the loose."

An interesting open forum was one of the features of the convention. Many took part in the discussions on cable costs, free service, collection and construction matters.

"Absent Subscribers'" Service on Trial in England

London, Eng.—"Absent subscribers' telephone service" was initiated, as an experiment, on April 1st by the Post Office. The City exchange was selected for testing the service, under which a subscriber, before going out and leaving his telephone unattended, may inform the exchange how long he will be out and where he may be found, for the benefit of persons ringing him. The fee is: For any period of interception not exceeding four hours, sixpence; exceeding four hours, one shilling. For every call intercepted a charge of a penny will be made. The minimum period for interception is half-an-hour, and the operator continues to intercept calls until the subscriber returns and notifies the switchboard.

Pierre, S. D.—Private exchange at South Dakota state capitol, has been sold to Dakota Central Telephone Co.

The Common, or Brigg's, System of Logarithms*

By F. J. DOMMERQUE,
Fellow A. I. E. E.

61. Definition

Before going any further in the discussion of physics it will be expedient to familiarize the reader with logarithms, a most useful and to the practical engineer, whose work calls for a great amount of figuring, indispensable time- and labor-saving implement of mathematics. The formulae used in modern telephony are so saturated with logarithms and expressions based upon logarithms that a knowledge of this branch of mathematics is essential to the education of anyone desirous of studying the most important physical phenomena underlying telephone operations of today.

The reader will recollect from section 12 of the article on "Involution and Evolution," what "power," "base" and "exponent" mean. In the expression or equation $a = b^m$ the quantity a designates the power, b the base and m the exponent, From the earlier discussion we have learned to determine the value of b as $b = \sqrt[m]{a} = a^{\frac{1}{m}}$, but we did not learn how to find the value of m. This we will learn now. To start with, let us give to the base the value 10 and let "a" equal 10^p, then p is designated as the *"logarithm of a to the base* 10, which is written in mathematics as $p = \log a$. Log is the abbreviation of logarithm and the suffix 10 designates that the logarithm is to the base 10. Thus we can say: *The common logarithm of a quantity "a" is the exponent of the power to which the base* 10 *must be raised to equal that quantity.* It must be mentioned that the logarithms to the base 10 are called common logarithms and also Brigg's logarithms. If we write the value of m, which may now be determined from the equation $a = b^m$, as $m = \log a$, we obtain a logarithm which is not to the base "10" but to the base "b." Of course there can be logarithms to any base, but the logarithms to the base 10 are the most commonly used.

The following examples will give the logarithms of the powers of 10 with positive and negative integral exponents:

It is—

$10^0 = 1$, whence $0 = \log_{10} 1$
$10^1 = 10$, whence $1 = \log_{10} 10$
$10^2 = 100$, whence $2 = \log_{10} 100$
$10^3 = 1000$, whence $3 = \log_{10} 1000$

and so on; for negative exponents it is—

$$10^{-1} = \frac{1}{10} = 0.1, \quad \text{whence}$$
$$-1 = \log_{10} 0.1$$
$$10^{-2} = \frac{1}{100} = 0.01, \quad \text{whence}$$
$$-2 = \log_{10} 0.01$$
$$10^{-3} = \frac{1}{1000} = 0.001, \quad \text{whence}$$
$$-3 = \log_{10} 0.001$$

and so on.

It has become customary to leave off the base 10 in writing common logarithms and we will do so hereafter.

It is a ittle more cumbersome to determine other logarithms to the base 10, as for instance $10^{\frac{1}{2}}$. We know that $10^{\frac{1}{2}}$ equals $\sqrt{10}$, which is 3.1622...., therefore it is $\frac{1}{2} = 0.5 = \log 3.1622.....$

As logarithms are so commonly used on account of their convenience as we will learn soon, tables have been computed, which give the logarithms of any number. These tables are more or less extensive, it depends upon the accuracy; that is, upon the number of decimal places, the logarithms are to be calculated to. More about this later.

Reverting again to the above exponents of 10, we may now write the results as:

$\log 1 = 0$
$\log 10 = 1$
$\log 100 = 2$
$\log 1000 = 3$

and so on; and

$\log 0.1 = -1$ or also $= 9 - 10$
$\log 0.01 = -2$ or also $= 8 - 10$
$\log 0.002 = -3$ or also $= 7 - 10$

and so on.

Thus we see that the logarithms of all positive single-place numbers commence with 0; the logarithms of all positive two-place numbers with 1; the logarithms of all positive three-place numbers with 2; the logarithms of all positive four-place numbers with 3, and so on. From this we infer that the logarithm of any number between 1 and 10 lies between 0 and 1; the logarithm of any number between 10 and 100 lies between 1 and 2, and so on. This may be expressed also as follows:

The logarithm of any number with *one* figure to the left of its decimal point is equal to 0 plus some decimal, the logarithm of any number with *two* figures to the left of its decimal point is equal to 1 plus some decimal; the logarithm of any number with *three* figures to the left of its decimal point is equal to 2 plus some decimal, and so on.

By the same train of reasoning we find that the logarithm of any number between 0 and 0.1 lies between 0 and -1; for any number between 0.1 and 0.01 between -1 and -2; for any number between 0.01 and 0.001 between -2 and -3 and so on.; and consequently the logarithm of any number between 1 and 0.1 lies between $10-10$ and $9-10$; the logarithm of any number between 0.1 and 0.01 lies between $9-10$ and $8-10$; the logarithm of any number between 0.01 and 0.001 lies between $8-10$ and $7-10$; and so on; which again can be stated as follows: The logarithm of any decimal with *no* zeros between its point and first figure is equal to 9 plus some decimal -10; the logarithm of any decimal with *one* zero between its point and first figure is equal to 8 plus some decimal -10; the logarithm of any decimal with *two* zeros between its point and first figure is equal to 7 plus some decimal -10; and so on.

The above explanations clearly show that the logarithm of any number consists of two parts, one to the left of the decimal point, which is the integral part, and the other to the right of the decimal point, which is the decimal part. The integral part is called the *characteristic* of the logarithm, and the decimal part its *Mantissa.* The only exceptions are the numbers 1, 10, 100, 1000, etc., and 0.1, 0.01, 0.001, 0.0001, etc., the logarithms of these numbers are integrals only; that is, they have a characteristic but no mantissa, while all other numbers have a decimal fraction; that is, a mantissa also. This mantissa is infinitely long; that is, it can never be written to the end. Only on very rare occasions more than seven decimal places are required, in most cases four or five places are sufficient, and even in the most refined calculations not more than six or seven places are necessary.

From tables of logarithms it will be found, for instance, $\log 51.263 = 1.70980$; here 1 is the characteristic and 70980 is the mantissa. As will be seen there are two places to the left of the decimal point, therefore the characteristic of the logarithm must be 1. Only five places

**Fourteenth article on Telephone Mathematics and Physics.*

of the mantissa are given, in reality there are an infinite number of places.

This is a positive logarithm; a negative logarithm would be written positive but the integral characteristic would be subtracted from the mantissa; for example, log 0.98216 would be 0.99218 — 1, which is the same as — 0.000782. The logarithmic tables give the value 99218 for the mantissa. It may be explained right now that all tables of logarithms give the mantissa only, as the characteristic is so easily determined from the position of the decimal point and can thus be written down at a glance.

62. A Logarithmic Scale

As it would take too much space to print a table of logarithms in these columns, and as anyone whose occupation demands a considerable amount of calculating, will be in possession of such a table, which is contained in nearly all technical pocketbooks, we desist from inserting one here, but instead we give a scale in Fig. 78*, which will enable the reader to find the logarithm of any number and incidentally perform some other operations, which will be explained hereafter, such operations being an application of logarithms. To the left of the scale are shown two dotted lines marked AB and CD respectively. These lines indicate division lines between the different sections of the scale, one section being marked A =, another B =, a third one C =; the section marked D = is independent of the logarithmic part and simply divides the scale into sixteenths of an inch. At this juncture we are interested in the sections B and C only. As will be seen the scale of section B differs from the scale of section C; where 2 is marked on section B, we find 3 on section C, and where 4 is marked on section 4 we find 6 on section C. The scale of section C gives the mantissae of the numbers indicated on the scale of section B above. Therefore, if one desires to find the logarithm of a number, he will locate this number on the scale of section B and read the corresponding value below it on the scale of section C, this gives him the mantissa. The characteristic of the logarithm is not found from the scale as it is the number of places to the left of the decimal point of the given number less 1. We will insert an example or two. Suppose the logarithm of the number 270 is wanted. Locate 270 in scale of B; below this, on scale of C is found the value 430 and a little more; it will be as close as one can read to say the mantissa is 431. This is the decimal part of the logarithm. Now there are 3 places in the number 270 to the left of the decimal point, 270 being a whole number. Therefore the characteristic is 3 — 1 or 2, and the result is log 270 = 2.431.

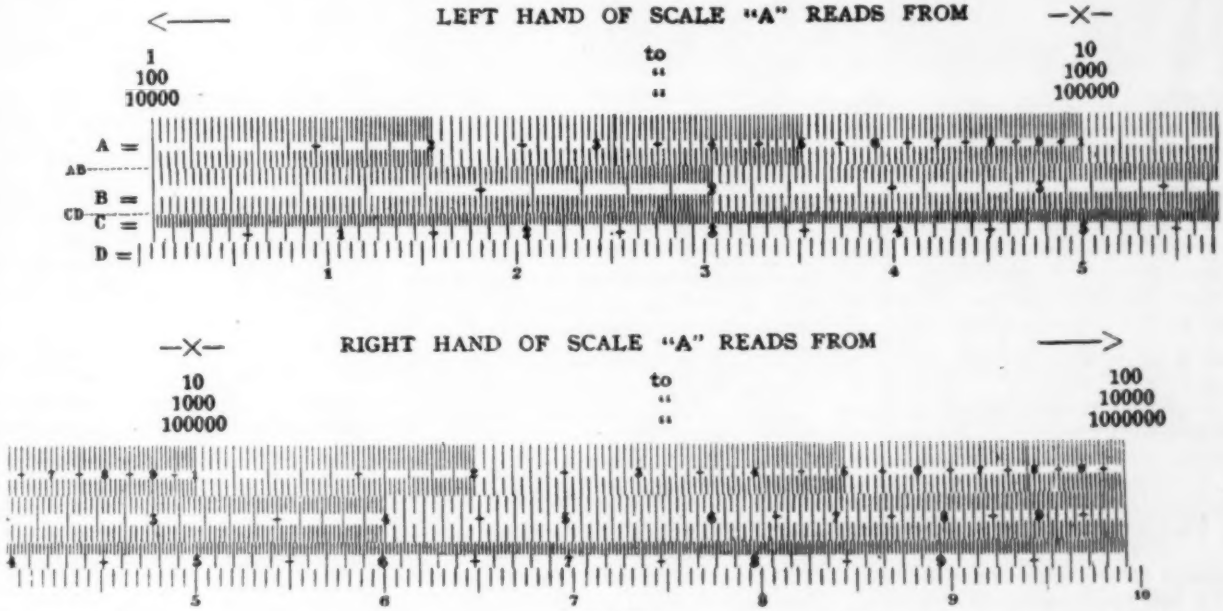


Fig. 78

Another example would be to find the logarithm of 0.061; locate 61 on the scale of B and find below it on the scale of C the value 785 which is the mantissa. To determine the characteristic, recollect what was just said for any decimal with one zero between its decimal point and first figure, namely that its logarithm is equal to 8 plus some decimal — 10; the decimal or mantissa in our example is 785, whence the complete logarithm is log 0.061 = 8 + 0.785 — 10 = 8.785 — 10. Of course this process of finding the logarithm by means of a logarithmic scale is, as can be seen, a rather vague method, but it will do for most cases in practice; for real scientific work comprehensive tables will be necessary.

63. Operations by Means of Logarithms

First a few properties of logarithms. As a^0 equals 1 for any value of a, we have $0 = \log_a 1$, which means that *the logarithm of unity is zero.* Furthermore, as $a^1 = a$ we have $\log_a a = 1$, which means that *the logarithm of the base itself is unity.*

Although the following rules are applicable to logarithms to any base, we will develop them for the common logarithms for sake of simplicity.

If $m = \log a$, it follows $10^m = a$ and if $n = \log b$, it follows $10^n = b$, hence by multiplication $10^m \times 10^n = a \times b$ or $10^{m+n} = a \times b$; whence $m + n = \log (a \times b)$ or as $m = \log a$ and $n = \log b$, also $\log a + \log b = \log (a \times b)$. This shows that *the logarithm of the product of two factors is equal to the sum of the logarithms of those factors.* The same rule can be extended to any number of factors.

By division of the two equations $10^m = a$ and $10^n = b$ we obtain $\frac{10^m}{10^n} = \frac{a}{b}$, or $10^{m-n} = \frac{a}{b}$, whence $m - n = \log \frac{a}{b}$ or $\log a - \log b = \log \frac{a}{b}$.

This shows that *the logarithm of a fraction is equal to the logarithm of the numerator minus the logarithm of the denominator.*

Now assume again $m = \log a$, whence $10^m = a$ and raise both sides of the equation to the nth power; then $(10^m)^n = a^n$, or $10^{mn} = a^n$, whence $nm = \log a^n$ or $n \times \log a = \log (a^n)$.

This shows that *the logarithm of a power of a quantity is equal to the logarithm of the quantity multiplied by the exponent of the power.*

**In the figure the logarithmic scale is shown in two halves on account of facility in printing. In reality the scale is in one piece, ten inches long. Therefore, the two parts should be joined at the 5-inch mark in lower section D.*

If, instead of raising both sides of the equation $10^m = a$ to the nth power, we extract the nth root, we obtain $\sqrt[n]{10^m} = \sqrt[n]{a}$ or $\frac{m}{10^n} = \sqrt[n]{a}$, whence $\frac{m}{n} = \log \sqrt[n]{a} = \log \left(\frac{1}{a^n} \right) = \frac{\log a}{a} = \log \sqrt[n]{a}$. This shows that *the logarithm of a root of a quantity is equal to the logarithm of the quantity, divided by the index of the root.*

The described logarithmic operations teach us how to transform multiplication into addition, division into subtraction, involution into multiplication and evolution into division. We have not gone deeply into the subject, our sole purpose was to give to the reader a good conception of logarithms and not to train him to become an expert in using them, the engineers who use them daily are amply conversant with their theory anyway. For this reason we will not enumerate a great number of examples but give only one, which combines the operations, and leave it to the reader to study this one thoroughly.

Suppose the logarithm of the fraction $\frac{51.623^2 \times 5.7821^3}{\sqrt{772.45} \times 0.98216}$ had to be found. To render matters easier, substitute for the figures in the expression letters, thus: $\frac{a^2 \times b^3}{\sqrt{c} \times d}$; then the logarithm of the expression would be written as $\log \frac{a^2 \times b^3}{\sqrt{c} \times d}$; by observation of the rules just developed it is $\log \frac{a^2 \times b^3}{\sqrt{c} \times d} = [2 \log a + 3 \log b] - \left[\frac{1}{2} \log c + \log d\right]$. (It is left to the reader to deduce this value in detail).

The now following values of the logarithms have been determined from a table, as the scale of Fig. 78 would not give values accurate enough for printing in a publication. To solve our problem we proceed as follows:

It is—
Log a or log 51.263 = 1.70980
and 2 log a = ...3.41960
Log b or log 5.7821 = 0.76200
and 3 log b = ...2.28627

Whence log of nominator = ...5.70587

It is—
Log c or log 772.45 = 2.88787
and ½ log c = ...1.44394
Log d or log 0.98216 =
0.99218—1 = ...0.99218—1

Whence log of denominator = .1.43612
Then the logarithm of the fraction = 5.70587 — 1.43612 = ..4.26975

But in practical calculations the logarithm would not be of much use, one wants to know what value the fraction itself has. Now that can be ascertained very easily by finding in the table of logarithms or also on the scale the number corresponding to the mantissa of the logarithm; the characteristic tells that the decimal point is to be placed after the number of figures indicated plus one, in our example this would be after 4 places plus one. The number corresponding to the mantissa 26975 is 18610, which has five places, as indicated by 4 + 1. In the logarithmic scale, Fig. 78, the number corresponding to the logarithm is found by locating in the scale of C the mantissa 26975 and reading just above it in the scale of B the number 18610. We call the reader's attention to the last sentence of section 12 on Involution and Evolution, which states: "It may be said that the long method of extracting roots is hardly ever used. Those that have to do that kind of calculating use tables of roots or make use of logarithms of which we will speak some other time. This promise is hereby fulfilled.

It will be seen from the logarithmic scale in Fig. 78 that the B scales (there are two of them, which are identical, one above the dotted line CD and one below the dotted line AB), differ from the A scales (of which there are also two) insofar as the A scales consist of two equal parts placed one in continuation of the other, while the B scale represents one continuous scale only.

In connection with scales A and B the method may be illustrated by which the square and square root of a number can be found. Select for instance on scale B the number 4. This number 4 is immediately below 16 in scale A; 16 is the square of 4 and 4 is the square root of 16. Locate 25 in scale B, then 25^2 or 25×25 is found in the left hand of scale A immediately above the 25 in scale B as 625; 25 is the square root of 625. If, therefore, the number 625 were given and the square root of 625 required, the number 25 would be located in scale A and 25 would be found in scale B. If 25 is the square root of 625, then 2.5 is the square root of 6.25 and 250 is the square root of 62500. But to get the square roots of 0.625, 62.5 and 6250, these values are found on the right hand of the scale A, in scale B between 6 and 7, the answer being 0.79...., 7.9.... and 79.... respectively.

It will be observed that scale A runs from left hand, commencing at 1, the middle of the scale being 10, the extreme right hand of the scale being 100. The left hand of scale A therefore reads from 1 to 10, or 100 to 1000, or 10,000 to 100,000. This will explain the reason for finding the square root of 6.25, 625 and 62,500 immediately below line AB, left hand of scale A, whereas the square root of 0.625, 62.5 and 6250 will be found below the line AB, right hand scale of A, in scale B.

64. The Slide Rule

An inspection of the logarthmic scale in Fig. 78 will divulge with reference to the two identical scales of A and B, that, if the entire scale were made of wood and a strip of it cut out, so as to leave the upper A scale and the lower B scale on the solid piece, while the lower A scale and the upper B scale would be on the strip cut out, and if this strip would be made to slide in grooves so that it could be moved back and forth, a *slide rule* would be obtained. Such a rule is used by practically all practicing engineers as a means of quick and easy calculation. All logarithmic operations can be performed on it by simply moving the slide to the right or to the left according to the operation required. The slide rule usually is provided with a runner or bridge of metal or of a piece of glass mounted in a metal frame. The metal or glass is marked with a straight line, whereby the graduations on the slide may be set in alignment with the graduations on the fixed rule at any desired point.

All operations mentioned can be performed with the slide rule and in addition a number of operations not explained. Of course, there are various scales required for the different operations and the slides must be provided with the proper scales.

The A and B scales mentioned above are suitable for multiplication and division and may also be used for some other operations, but as a rule different slides are used for different operations, the same scale, of course, serving for an operation and its reverse, as for instance for multiplication and division as we will show directly.

To multiply 2.5 by 3.5, locate the line at the beginning marked 1 of the slide opposite 2.5 on the fixed A scale and read above 3.5 on the B scale (on the slide) 8.75; this can not be easily done on our Fig. 78 as the B scale is not movable; if it were, it would come out, however, as described. What has been done is simply to add the log of 3.5 to the log of 2.5. No attention needs to be given to the decimal point in this operation, because the scales represent mantissae.

Division being the reverse of multiplication is performed by subtracting the logarithm of the denominator from the logarithm of the denominator, which is done by setting the divisor on B scale under the dividend on A scale and reading the quotient in the A scale where the commencing, that is, 1 of the B scale, is found.

We will not prolong the discussion of the slide rule as anyone with sufficient opportunity for the use of a slide rule

will have plenty of information on hand for its handling.

65. Napierian Logarithms

Of all the bases outside of the base 10, the base 2.71828.... is about the only one of importance; all through the science of physics this number, which is infinite, makes its appearance in numerous formulae, many of which are of particular weight in solving telephone problems. The reason for the prevalence of the 2.71828 can not be explained here, but it will become clear as progress is made in our mathematical discussions.

It has been customary to designate the 2.71828 by "e," but as this letter is frequently employed in electric writing as designation of an electromotive force, the writer has, in common with other electrical men, adopted the Greek letter "ϵ" instead.

This system has been named after Napier, the inventor of logarithms; but often the designation "Natural Logarithms" or "Hyperbolic Logarithms" is encountered; the latter expression hints at the fact that the number ϵ is at the bottom of hyperbolic functions.

Although tables of Napierian logarithms have been computed, tables of common logarithms may serve for the determination of Napierian logarithms of a number. There exists the relation between the two systems:

$$\log_\epsilon n = 2.3025851 \log_{10} n$$
$$\log_{10} n = 0.4342945 \log_\epsilon n$$

Notice that 2.3025851 is the reciprocal of 0.4342945.

As an example it may be desired to find the value of $\log_\epsilon 586.324$. The tables of common logarithms give for log 586.324 the value 2.768138. Dividing this value by 0.4342945 we obtain 6.373873; therefore $\log_\epsilon 586.324 = 6.373873$.

Orange County Keeps Fleet Busy

Middletown, N. Y.—Motor transportation is a big factor in helping the Orange County Telephone Company keep its service at top-notch. Of the fleet of motor vehicles operated by the company, and shown in the accompanying illustration, General Manager Frank D. Fancher writes:

"The drivers are standing in front of their respective cars. The first car on the left is an Overland Whippet coach, driven by Roscoe Conkling and used for installation and trouble work. The second car is a Chevrolet coupe, driven by Charles Startup and used for installation and trouble work. The next car is a Ford coupe, driven by Frank Carey, used for installation and trouble work. The next car is a Ford coupe, driven by Smiley Ogden, plant superintendent. The next car is a Ford coupe, driven by Louis Post, used for installation and trouble work. The next car is a Ford ton truck, driven by Edward Melfie, our cable splicer. Alvin Budd, his helper, is standing next to him. The next car is a 2½-ton truck, driven by Ben Conklin, the foreman. The man standing directly in back of this truck is Frank D. Fancher, general manager. Mahlon Tyrrell is standing at the right of Frank D. Fancher. He is assistant to the plant manager and drives the next car, which is an Essex coach. Mr. Charles C. Chappell, vice-president and general counsel, stands directly in back of the Essex coach and Mr. Ayres, plant manager, stands beside him. The last car is a 3-ton truck, Harry Terwilliger, the foreman, is standing near the rear of the truck.

"The two heavy trucks are equipped with power-driven winches and pole derricks. They are also equipped with standard A. T. & T. style bodies. The cabs on these trucks are not standard A. T. & T. cabs as they are enclosed. We are furnishing closed cars for all of our men with the exception of our cable splicer. The next time this car is replaced we will replace it with a car having an enclosed cab. All of our coupes and coaches are equipped with heaters, as we feel that the men are made more comfortable in a heated car and will do better work if they are kept warm and dry while traveling."

Kellogg's Show at Des Moines

Kellogg Switchboard and Supply Company's display at the Iowa convention showed a complete service demonstration board in operation. This was one of the high points of interest. There also was shown a Kellogg Unit type Universal board and a complete line of magneto and common battery telephones and miscellaneous apparatus on display.

Rhinelander, Wis.—Rhinelander Telephone Co. begins work on new exchange building to be completed by fall.

Tampico, Mex.—Service has been inaugurated between Tampico and Mexico City.

Midland, Tex.—Midland-Odessa telephone plants, owned by Alderman Telephone Co., Dallas, are being rebuilt.

Laurens, S. C.—Continental Telephone Co., St. Paul, Minn., has bought Laurens Telephone Co.

Smoothing Oute
With Thr

FROM the teleph s
convenience of op d
are of first importanc

The Como-Fone meets uir
Compact in design—ans
and transmitter comb sin
of design that makes it da
home or well-appointe

The Como-Fone offe hes
that make telephonin re.
free. The transmitte s
from the mouth. You un
fortable position — eit g
using this handy telep

There is a style of C fo

"For Greater Serv ph

American Ele

State an
Chic S

Branch Office an K
Succ ss

Monarch Tele uf

Americ Co

Monarch
Telephone Equipment
and
Supplies

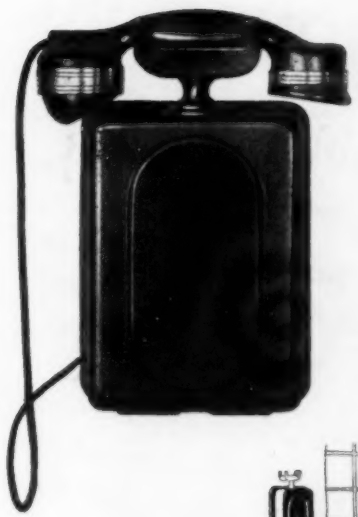
Oute Day's Routine Thomo-Fone

he teleph standpoint ease and
ce of opd pleasing appearance
mportanc

one meetsuirements to perfection.
design—ansmission—the receiver
er combisingle unit—and beauty
makes itdaptable to the modern
appointed

one offerhese little conveniences
lephoningre. One hand is always
ransmitteys the proper distance
th. Youume an easy and com-
tion—eitg or standing—when
ndy telep

yle of Cfor every user.



eater Sernphone Companies"

n Elc Company, Inc.

tate an Streets
Chic S. A.
nch Office an Kansas City, Mo.
Sucness to
narch Telufacturing Co.

Americ Company

Burns
Radio Products
and
Office Specialties

Know What You Buy
Buy What You Know

"COPPERWELD"
TRADE MARK REG. U.S. PAT. OFF.

TELEPHONE WIRE

Has an Established Reputation

Over three hundred million feet sold in the past five years.

Such results didn't just come about. They have been won on the dependable QUALITY and SERVICE that only COPPERWELD can give.

The GENUINE may be identified by the "COPPERWELD" Trade Mark on tag attached to every coil—look for it.

"COPPERWELD" "ECCO BRAND"
Insulated Twisted Pair Drop Wire
is guaranteed by
COPPERWELD STEEL COMPANY
and
HABIRSHAW CABLE & WIRE CORP.

Double assurance of absolute dependable quality. No other drop wire has such a guarantee.

Insist on getting the GENUINE LONG LIFE DROP WIRE.

"COPPERWELD"
Products Include
Line Wire
Drop Wire
Ground Rods
Ground Wire Clamps
Cable Rings
Staples, Nails

COPPERWELD is composed of a steel core, protected by a thick layer of molten copper, continuously and permanently welded to it by the Molten Welding Process.

Sole ARISTOS COPPERWELD Maker

There never has been, nor is there now, any other "copper-covered steel" or "copper-clad steel" made like "COPPERWELD" —by the Molten Welding Process.

JOBBERS OF
All Kinds of Telephone Materials and Supplies
Used by the Independent Telephone Companies

American Electric Company, Inc.
State and 64th Streets
Chicago, U. S. A.
Distributor to the Independent Telephone Trade

DISTRIBUTOR OF
"COPPERWELD"
Line Wire, Drop Wire, Ground Rods, to the Independent Telephone Trade
Trade Direct or Through Jobbers

How to Read Telephone Circuit Diagrams

By DAVID S. HULFISH

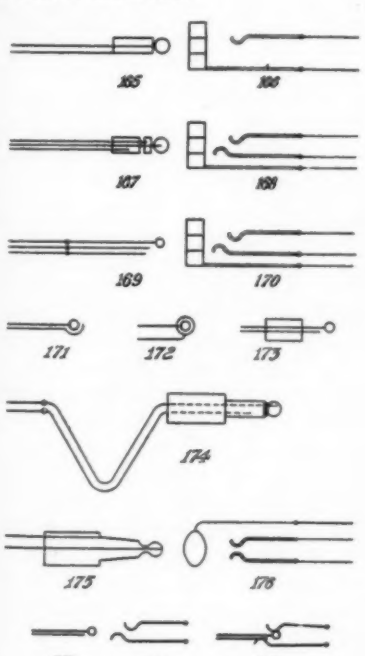
CHAPTER IV

(Copyright, 1927)

Jacks and Plugs

A number of unusual plug and jack symbols are shown in the group comprising Figs. 165 to 179. In Fig. 169, the wires are stopped at the locations of the parts of the plug which they serve. Figs. 171 and 172 show end view of the plug, the tip diameter being drawn smaller than the sleeve to show the sleeve behind it. Figs. 175 and 176 are companion symbols for a plug and jack, as taken from the drawings of a German patent. The two jack springs are of the same length and both connect to the tip of the plug. While the plug symbol shows no insulation, yet it must be of two parts, insulated from each other, and there are two conductors leading from the plug.

Figs. 177 and 178 show associated plug and jack. In Fig 179, the two symbols are shown connected.



Figs. 165 to 179. Unusual Plug and Jack Symbols.

Fig. 180 presents a sectional view of a specialized plug. In this plug, the part *n*3 is isolated, except while the back end of the plug is pressed upon, as would be the case when the plug is being pushed into a jack, at which time the spring *n*6 in the shaft of the plug would yield and the part *n*4 would make contact electrically with the part *n*3. The screw part *n*5 slides back by the same action, and breaks its connection from its conductor in the cord. The plug here shown is therefore a combined switchboard plug and automatic switch or perhaps automatic ringing key. It is well represented by the symbol of Fig. 181, although without the association of the mechanical drawing of Fig. 180, the symbol of Fig. 181, hardly would be intelligible.

Fig. 180. Sectional View of Specialized Plug.

Another specialization of parts is shown in Figs. 182 to 185. In Fig. 182, a two-conductor plug is shown in a jack of unusual formation, since the springs of the jack are not in contact with each other with the plug fully inserted. Three types of plug are shown, and but one jack. The circuit diagram of Fig. 185 is explained by the drawings of the jack

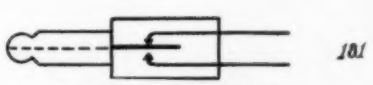
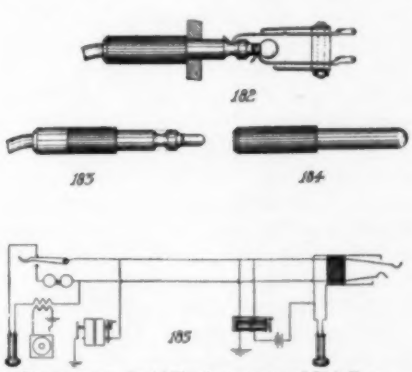


Fig. 181. Symbol of Special Plug.

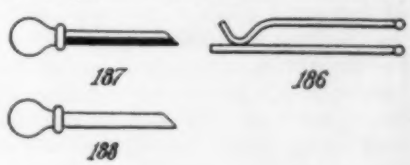
and plugs shown in connection with it. When the plug of Fig. 184 is inserted in the jack, the long springs of the jack are spread to connect the telephone line to the operator's telephone set, shown as



Figs. 182 to 185. Special Plug Arrangements and Their Uses

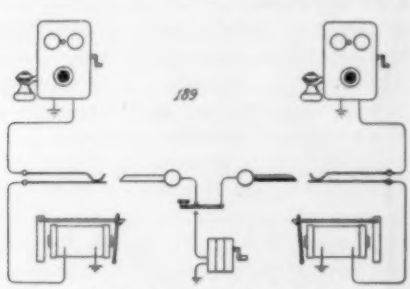
a single receiver below the jack. No flexible conductors are required in connection with the plug to effect this result, but the plug should be of insulating material, or of two insulated metal parts. When the plug of Fig. 183 is inserted or withdrawn, the long spring of the jack closes a circuit through a battery and the restoring coil of the drop, and the drop thus is restored without affecting the operator's set. When the plug of Fig. 182 is used, the operator may listen upon the conversation by withdrawing the plug slightly, such enough to spread the jack springs to make contact with the points of the jack.

A third set of specialized plugs and jacks is shown in Figs. 186 to 189. In Fig. 186 a jack of two conducting parts is shown, the two parts being electrically in contact. In Fig. 187 is shown a flat plug adapted to slip between the two conducting parts of the jack of Fig. 186, but having an insulating surface which would permit electrical contact with the



upper spring of the jack, but not with the lower spring. In Fig. 188 is shown another plug, similar in shape, but without the insulating surface, whereby the plug when inserted in the jack of Fig. 186 would make connection electrically with both of the conducting parts. These details enable the circuit diagram of Fig. 189 to be understood.

In Fig. 189, when the two lines are connected by the pair of plugs, the conducting plug permits the drop of the left-hand line to remain in connection with the line conductor during the conversation as a means for receiving a



Figs. 186 to 189. Types of Plug Switches.

clearing signal; while the plug at the right disconnects the drop of the line at the right of the figure, not only removing the drop as an unnecessary element, but also permitting the ringing key

of the plug pair to be operated to ring upon the line at the right without affecting the drop of that line.

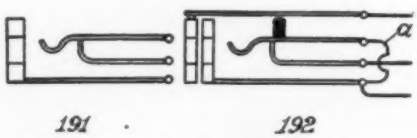
Switching Jacks

By "switching jack" is meant a jack which switches or modifies a circuit other than any circuit of which the plug conductors form a part. The simplest type is shown in sectional view in Fig. 190 and in symbol in Fig. 191. A frequent use of the switching function of this jack, namely, the function of breaking a circuit when a plug is inserted, is to remove the line drop from the circuit of the line when the line is connected by a plug. This action is seen by comparing Fig. 128 with Fig. 131.

A more complex switching jack, but still of general type of the jack of Fig. 190, is shown in sectional view in Fig. 193, and in symbol in Fig. 192. The jack body is of two metallic parts, and the body of any plug will make contact elec-

Fig. 190. Sectional View of Switching Jack.

trically with both parts. The top spring presents a circuit for an external circuit wire, and normally is in contanct with the outer jack body. The conductor *a* of the symbol does not exist as a wire in the jack, but its function is effected by the direct contact of the spring in the vertical portion at the back end, where it lies against the back end of the cast metal body of the jack. Thus the mechanical structure of the jack is not followed in the symbol, but every detail of the electrical functions of the jack is represented in the symbol.



Figs. 191 and 192. Switching Jack Symbols.

In Fig. 194, the body of the plug makes contact with two conductors, one of which is represented as the body of the jack and the other as a spring located so near to the body part of the symbol that the shaft of the plug connects with both the body of the jack and its long spring. This jack, if associated in a drawing with a two-conductor plug, would have this manner of operation confirmed.

In Fig. 195 is presented a symbol for a jack having the feature of a temporary or transient contact. As the tip of the plug passes, it connects together the two long springs of the jack; as it passes further, it engages the two short springs, pressing them apart so that the long springs are lifted from the plug by the lifting action of the short springs.

The jacks thus far presented have involved the metal of the plug in the jack circuits. In Fig. 196 is presented a jack with a three-spring switch added, the switch being controlled by the plug, but electrically independent of the circuits and conductors of the plug. Such jacks are common; for instance, the battery points of the speaker plug of a radio telephone receiving set.

Switch Keys

An electrical switch, as the term generally is used, is any kind of electric

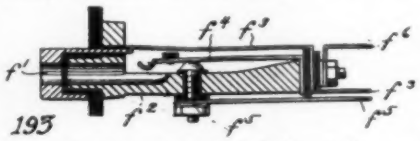
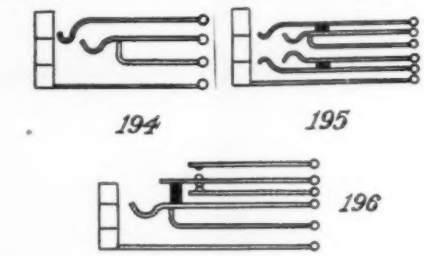


Fig. 193. Type of Switching Jack.

circuit-changing apparatus. The simplest of switches is the so-called "two-point" switch, which consists of a fixed member and a movable member, for opening and closing one wire. It is illustrated by the



Figs. 194 to 196. Diagrams of Switching Jacks.

symbols of Fig. 211, Fig. 218 and Fig. 219; Fig. 213 also represents such a switch, the small circle at the right being added and left unconnected, to show that the switch has an "open circuit" position.

This simple device bears the name of "switch." On the other hand, the automatic telephone central office is equipped with switches approaching in size a self-player piano and far surpassing the piano in complexity, containing usually terminals of one hundred lines and sometimes as many as one hundred trunks, with operating magnets and relays and pawls and wheels and springs innumerable, adapted as a whole to connect any one of the lines to any one of the trunks; and this also bears the simple name of "switch."

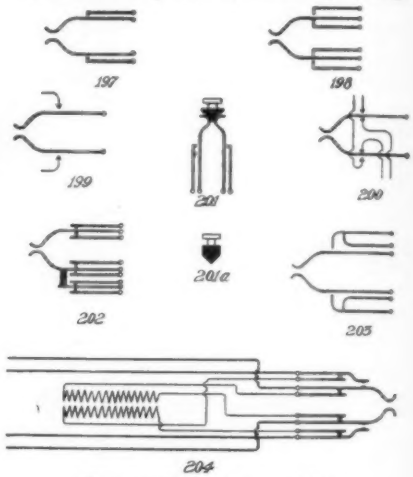
Switches will be discussed under three chief classes: First, the manual switch, or key; second, the electromagnetic switch, or relay; and third, the automatic switch, which is a system of relays so highly specialized as to form a class for itself. The intercommunicating switch is a manual switch, developed to the same purposes as the automatic switch, and may be classed with the automatic switches.

The key, or manual switch, takes the form of a few small flexible springs operated by a handle. Usually the springs are mounted upon the under side of a shelf, called a keyboard, and the operating handles are upon the upper side of the shelf. The handles may be push buttons or rocking knobs.

The general principle of the symbol is that a main spring or moving spring is shown, or a pair of them, and about these are grouped the auxiliary springs or contact points. The auxiliary springs frequently are arranged to make or break contacts among themselves.

In Fig. 197 is shown a symbol for operator's listening key. In Fig. 198 the symbol usually used for the operator's ringing key is shown. For circuit connections with such a symbol, see the key symbol at the right in Fig. 135. The possibilities of combinations in the springs of the keys in a telephone switchboard are countless.

The contact points or auxiliary springs



Figs. 197 to 204. Telephone Key Symbols.

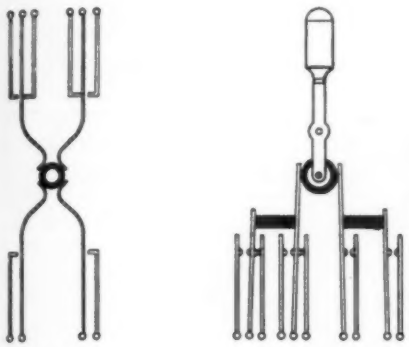
of the keys have but little movement, as a rule, and theoretically need not have any movement at all. For this reason, they frequently are shown, not as springs, but as fixed points. See Fig. 199, which is a modification of the symbol of Fig. 197; also Fig. 200, a modification of Fig. 198. In Fig. 201, the plunger with push-button head is shown in the symbol; the key is the same as Fig. 199 electrically.

The symbol of Fig. 203 involves a fundamental principle in the reading of key symbols in a telephone circuit diagram. It is necessary to consider the conditions which exist from instant to instant as the key passes from one position to the other. In the key of Fig. 198 or of Fig. 200, the main or moving springs may break contact from the inner contact points before making contact with the outer contact points; thus for a moment the circuit leading to the main springs would be opened. As a ringing key, this is desirable; but for some signaling circuits it might be desirable to hold the circuit closed, changing the path of current from the inner contact to the outer contact without interrupting the flow of current for even the smallest interval of time. This requirement is fulfilled by the key symbolized in Fig. 203. It is called a "make-before break" key and some-

times "MBB" is written near the symbol.

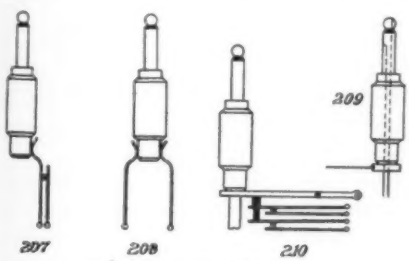
A key of eight springs is shown in Fig. 204. This key is called a "repeating-coil key" because its arrangement of springs and contacts is such that it will insert a repeating coil into a pair of wires by a movement of its handle.

A key having but one handle but having two systems of springs so arranged that either system may be operated independently of the other, is called a combination key. Such a key is represented by the symbols of Figs. 205 and 206. In Fig. 205, the lower end is a listening key and the upper end is a ringing key. This type of key is met in diagrams of plug-pair circuits. In Fig. 206, the key is similar electrically, but different mechanically. Other symbols may represent a combination key. See Fig. 230 and the text referring to it.



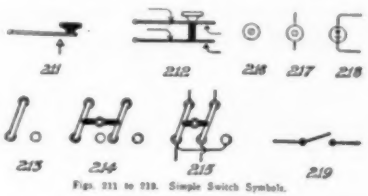
Figs. 205 and 206. Combination Keys.

In addition to the keys, or manual switches operated directly by the hand of the operator, there may be switches operated by the plugs when they are lifted from their sockets, or position of rest. These are called "plug-socket switches," and four types are illustrated in Figs. 207 to 210. In Fig. 208, the metal body of the plug forms a part of the electrical circuit of the two springs, the circuit of the springs being closed through the metal of the plug when the plug is in its position of rest. In a diagram including the symbol of Fig. 208 or of Fig. 207, note should be made to see whether the cord conductor running to the body of the plug is not in some way concerned in the circuits which are controlled by the plug switch. The symbol of Fig. 209 is presented to show the simplest type of plug-socket switch; the plug breaks the socket-switch contact when lifted. The switch of Fig. 210 is operated by the pull of the cord and the weight of cord and plug.



Figs. 207 to 210. Plug Switch Symbols.

Keys of the push-button type, having flat springs upon which the operating buttons are mounted directly are shown in Figs. 211, 212, and in Figs. 225 to 227. This style of symbol structure is widely used, being easy to draw and showing the electrical action very clearly. That such a symbol represents the key mechanically is not to be assumed in any instance. Fig. 211 shows the customary telegraph key; Fig. 212 shows the circuits of a telephone ringing key.

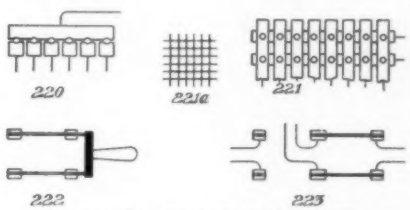


Figs. 211 to 219. Simple Switch Symbols.

Simple lever switches are symbolized in Figs. 213, 214 and 215. The conductors shown in Fig. 215 are the circuits known as "pole-changing." The function of the switch is to reverse the two pairs of wires with respect to each other. If one pair were connected to a battery, the switch connected as shown would reverse the polarity of the battery upon the other pair of wires.

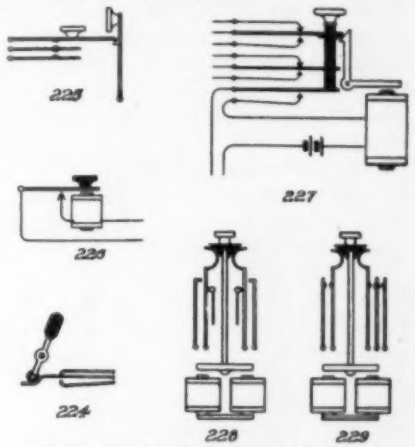
Figs. 216 to 218 show selected symbols for the ordinary push button, such as is used for door bells. From their associated circuits, such symbols may be recognized as switches, not as transmitters, which they resemble very much. In telephone circuit diagrams, they are most likely to be found in substation circuits.

Fig. 219 shows a switch symbol which is most thoroughly non-committal as to the mechanical type of switch construction.



Figs. 220 to 223. Plug Switches and Power Switches.

Fig. 220 is a "plug switch." This shorter name sometimes also is given to the plug-socket switches of Figs. 207 to 210. In the devices of Figs. 220 and 221, the plug is an element of the switch, has no other function, and exercises a selection among the possible circuits of the switch by the position in which it is placed. The plug in this case is a small cone or wedge of metal and connects two pieces of metal by touching both of them, as by being wedged between them. By inserting a conducting plug into any one of the circular openings between the long bar at the top and the small squares below it in the symbol of Fig. 220, a connection is established between the conductor leading out of the top of the symbol and a selected one of the conductors leading out of the bottom of the symbol. Such switches are common in lightning-arrestor equipments for substations, and in testing apparatus. They are used largely also as battery switches, and in telegraph circuits, because of their large current-carrying capacity and their compact form.



Figs. 224 to 229. Some Types of Symbols for Locking Keys.

Fig. 221 symbolizes an ancient type of telephone switchboard. Fig. 221a shows the more compact form of the symbol of Fig. 221. Horizontal conducting straps run from left to right, and the vertical straps cross them without touching them. The small circles represent holes drilled through both of the straps. A conducting plug in any hole would pass through both of the straps and connect them electrically. By this means, any vertical strap could be connected to any horizontal strap. In the earliest type of switchboard, every telephone line had a vertical and a horizontal strap, so that every line crossed every other, and one plug would connect any two lines. This type of switchboard was replaced by the switchboard having plugs with flexible cord conductors.

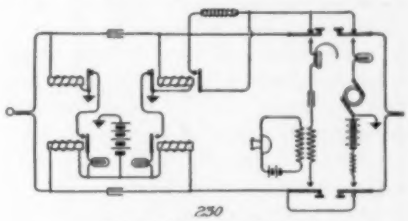


Fig. 230. Skeleton Diagram of a Plug Pair.

In Figs. 222 and 223 are shown symbols of double-pole power switches. These are met in the power-plant portions of the circuit diagrams, including the batteries of the switchboards.

Locking Keys

The "locking" type of key will stay in either position, remaining in its "normal" position until actuated by hand, and then remaining in its "actuated" position until

restored to normal by hand. A "listening" key is a type of locking key. Keys are locking or non-locking according to the requirements of the circuits in which they are found, but the circuit diagram very seldom indicates whether the key is locking or not, unless some special means is provided for locking or unlocking it.

With the key of Fig. 201, the locking feature may be indicated by a plunger of the shape shown in Fig. 201-a; a plunger of that shape would remain between the spread springs until pulled back.

Some specialized locking keys are shown in symbol in Figs. 224 to 229. The symbol of Fig. 224 shows a difference so small that the draftsman may overlook it. If the lever be pressed far enough, the black roller will pass the shoulder of the main spring and the handle will stay over, therefore locking the key; if, however, for some reason not shown in the symbol, the roller can not pass the shoulder, then the key is a non-locking key. The associated circuits will show whether the key should lock.

In Fig. 225, the push-button type of key symbol is shown, with an obvious latch, and with another push-button upon the latch member for unlocking the key. The key symbolized in Fig. 227 is the same, but with a magnet for unlatching it.

Fig. 226 shows the symbol of an electromagnetically locking key. When this key is closed, the current in the key-circuit will energize the magnet and the key will remain closed as long as current flows in the circuit.

Figs. 228 and 229 show two symbols somewhat similar. In both of these, the electromagnet must remain energized as long as the key is required to hold its actuated position, the key returning to normal position as soon as the holding electromagnet is de-energized.

(To be continued.)

Rights Rates Forecast at Ohio Meeting As New Line-Up Result

Columbus, Ohio—"One thing we can safely predict in connection with these purchases and sales is that the telephone-using public is going to be asked to pay a reasonable price for the telephone service they will hereafter receive." So said Dr. C. L. Jones, Athens, re-elected president of the Ohio Independent Telephone Association at its best attended annual convention.

More than a thousand Ohio telephone men and fellow workers from other states, together with the operators who took part in the conference held during the meeting, gathered for a record state conclave.

The presidential address was a notable consideration of the probable effect of the many sales and mergers being made in the Independent field. Dr. Jones sees many favorable signs in these deals, in addition to the basic promise of reasonable rates. He referred to the newcomers making immediate improvements in the plants, a passing of the day when sentiment and meager returns ruled operations of many Independent plants, and the dawn of a new day in the telephone industry in which it is competing with the rest of the business world for brain, brawn and material, instead of competing with other telephone companies for subscribers. These three significant facts were expanded upon in the presidential address. He doubted that the new owners would be able to do much in working out operating economies or in decreasing overhead, citing the narrow profit margin of the industry as choking hope in this direction.

Dr. Jones stated what the politicians call an "epidemic of rate increasing and reorganization" is the only thing that insures the salvation of the Ohio telephone industry. He mentioned the proverbially poverty-stricken condition of many exchanges for a number of years as making the period of rate readjustment ten years overdue. He advised that those needing new financing get busy at once, for he doubted that the present "easy market" for utility securities would "last forever." Put up a good "front," he impressed upon his hearers, for the subscribers' opinion of their company often is based on the appearance of the company headquarters.

In the president's address and that of the re-elected secretary-treasurer, Frank L. McKinney, frequent reference was made to the work of the association in combating unfavorable legislation. Ohio's telephone industry has been the particular object of political attack during the past year, but through the work of an active and capable association and co-operation of the members, serious damage was avoided.

Harmony Reigns

President MacKinnon of the national Independent association and President E. F. Carter of the Ohio Bell were two of the featured speakers on the program. Mr. MacKinnon reviewed national affairs and cited the possibility of national radio legislation having considerable importance to telephone companies in the future. He told of the national association's interested vigilance in national radio legislation and referred to a conference with J. J. Carty, Bell vice-president, concerning an international communication session, some years ago, as being one of the lessons of experience. With international telephony now an accomplished fact any commitments made several years ago by American interests might be proving highly embarrassing. He spoke of the relations within the Independent group, especially in helping the more than 8,000 B class companies, and of the present activities in telephone financing. "Banking houses need education," said MacKinnon, in relating cases where bond circulars refrained from telling "the truth, the whole truth and nothing but the truth," particularly concerning "net income before depreciation." The matter of depreciation was again referred to in the address of Frank J. Brookman, Rochester, N. Y., chairman of the eastern section of the accounting division of the U. S. I. T. A. This authority discussed the I. C. C. order on depreciation in the details that are not satisfactory to the Independents and told how the national Independent association is working to have these points modified.

Making Rates Acceptable

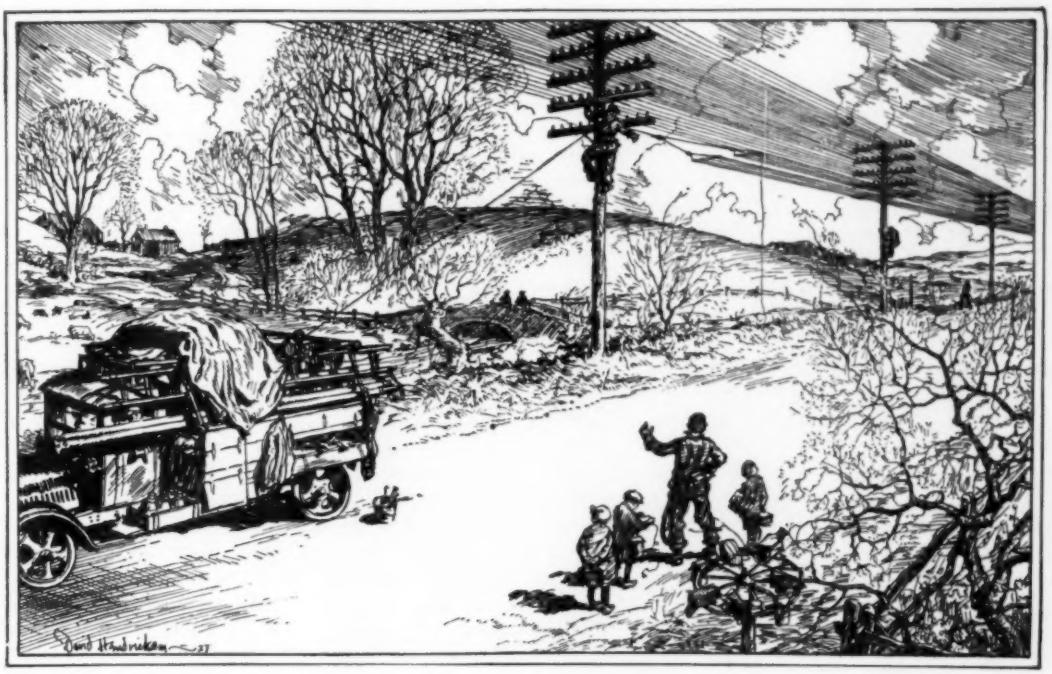
"Keeping Rates in Line with Values and Expenses" was the subject of the address made by Robert H. Jackson, general counsel of the Associated Telephone Companies, Jamestown, N. Y. He showed, with specimen advertisements, how his company took its case to the court of last resort, the subscribers. In cases where mergers made rate increases necessary the company laid down an advance barrage of informative and winning advertising to acquaint the community with the true situation. He stated that regardless of the power of the duly appointed rate regulation bodies the public would settle the rate cases in its own ways, and to get the public favorable to the company it is vital to tell the incontrovertible truth. He gave particulars of the very careful and thorough manner in which the company handled the details of the advertising campaign.

The Ohio Bell chief, Carter, spoke of the harmony that prevailed among Independents and Bell in Ohio and invited the Independents to visit the Bell's new home in Cleveland, now nearing completion, where he could extend the hospitality shown to him during his visits at the state's Independent exchanges. He spoke on the significant developments in the technical phases of telephony, on rate, tax and legislative matters as illustrating that there was one common cause between all telephone companies in the Buckeye commonwealth.

J. G. Ihmsen, vice-president and general manager of the Up-State New York Telephone Association, spoke on "What Your Association Means to You." He outlined the history and results of association work and analyzed eight points of association merit, which he mentioned as:

"It is a shock absorber interposed be-

(*Continued on page* 48)



Communication for a Growing Nation

An Advertisement of
the American Telephone and Telegraph Company

THE first telephone call was made from one room to another in the same building. The first advance in telephony made possible conversations from one point to another in the same town or community. The dream of the founders of the Bell Telephone System, however, was that through it, all the separate communities might some day be interconnected to form a nation-wide community.

Such a community for speech by telephone has now become a reality, and the year-by-year growth in the number of long distance telephone calls shows how rapidly it is developing. This super-neighborhood, extending from town to town and state to state, has grown as the means of communication have been provided to serve its business and social needs.

The growth is strikingly shown by the extension of long distance telephone facilities. In 1925, for additions to the long distance telephone lines, there was expended thirty-seven million dollars. In 1926 sixty-one million dollars. During 1927 and the three following years, extensions are planned on a still greater scale, including each year about two thousand miles of long distance cable. These millions will be expended on long distance telephone lines to meet the nation's growth and their use will help to further growth.

Studying the Details of Telephone Work

CHAPTER IV

By E. R. COLLINS,
Wire Chief, Manitoba Telephone System

A 5 gallon can of gasoline is a very commonplace object. There are several ideas that a can of gasoline can suggest. For instance, when we say there are 5 gallons the idea of size is suggested. We speak of this size or bulk in terms of gallons.

Then again the idea of weight will be thought of, and we immediately think in terms of pounds. Still again, the idea of quality will suggest a gasoline of a certain percentage test, while the idea of cost is forced upon one every time the old bus needs a drink. So we have the terms gallon, pound, percentage strength and cost all suggested by the can of gasoline. These terms are simply the means of providing a common language in which we can speak of gasoline and other substances.

When you lift the can up you might ask how much strength it takes to lift it a foot. We have then to denote the energy required, the term "foot pound," which simply means the energy or work required to raise one pound weight a vertical distance of one foot linear measure.

All matter is either at rest or in motion. Immediately any object is moved there are certain forces to resist its motion, such as gravitation, or air friction, or other friction of one substance rubbing against another. Here again we have the quantity of resistance and there are terms and quantities to express different degrees of resistance.

At the water works of your city there are huge pumps which pump the water into the water mains. The water travels through these pipes to your home. The pressure exerted by the pump is spoken of in terms of pounds pressure to the square inch, while the capacity of the pump is spoken of in so many hundred or thousand gallons of water per hour or per day. We will suppose that the pump exerts a pressure of 100 pounds per square inch at the pump. This term is applied to the force exerted by the pump, or the pressure or the potential of the pump.

The pipes through which the water must flow offer resistance due to skin friction of the pipe, the height the water has to be sent above the pump, and other factors. We have the term resistance, however, which denoted that power to hold back or resist the flow of water.

We will suppose again that the tap in your kitchen will pass 35 gallons per minute with 100 pounds pressure at the pump, with a ½-inch pipe leading into your house. Then we should expect that there will be a much larger amount of water flow with a 1-inch pipe with the same pressure at the pump. Or with the ½-inch pipe we can obtain a larger flow of water with a heavier pressure at the pump.

We have three ideas suggested then by the pump: first, the pounds pressure, or potential force at the pump; second, the resistance of the water pipe to the flow of water, and third the quantity of water resulting from these two opposing forces, that will flow from the tap in a given time. To intelligently talk about these values we need a common language to denote pressure, resistance and volume delivered. There are three terms referring to the flow of electrical energy, with which we must be familiar before we can proceed much further in our study of the telephone. They are the words, volt, ohm, and ampere.

In our previous experiments we learned that a flow of electrical energy can be obtained by chemical means, such as with a battery, or by electro magnetic means, such as disturbing the magnetic field in the core of an electro magnet. In this case the energy is supplied by the experimenter's hand in moving the permanent magnet or the coil. We speak of the pressure or electrical potential set up by either means of the battery or electro magnet, as so many volts pressure. This term is abbreviated and so we find the term electro motive force, or E.M.F., or simply the letter "E," all denoting the same idea of voltage. This idea is also abbreviated by the use of the letter "V." So we have the expressions, electro motive force,—E.M.F.—"E"—voltage, volt, and "V," all meaning the same thing.

There is also resistance offered by the wire or the electrical conductor. This resistance depends on the length and size of the conductor, also the kind of material used. The unit expression in this case is the word "ohm," which simply expresses a standard quantity of resistance offered to a flow of electrical current. Dr. G. S. Ohm was the first to work out this idea, in Berlin in the year 1827. We therefore refer to the electrical values under the heading of "Ohm's Law." A long copper wire of small dimensions will offer a much higher resistance than a short wire of the same dimension, and a copper wire of large size offers a lower resistance than a small size wire.

Iron wire has a much higher resistance than copper wire. The iron wire used for rural telephone lines is usually No. 12 iron. The number refers to the diameter, and the different grades as "B," "BB," and "EBB," denote different qualities of the iron. Such a wire will have a resistance of 33 ohms to the mile, for a single wire, or 66 ohms to the mile for a line and its return wire. A copper wire of approximately the same size and length, will have a resistance of 5 ohms for a single wire or 10 ohms for the two wires.

Resistance is also affected by temperature, and where tables of wire resistance are given, the temperature is 68 deg. Fahrenheit. A rise in temperature will cause a rise in resistance, and a fall in temperature will cause a fall in resistance.

The quantity of electricity per second that will be forced over a certain wire by a certain voltage is spoken of as so many "amperes," which is shown abbreviated as "amp," or by the letter "C" and sometimes by the letter "I."

The Three Quantities

We have, therefore, three quantities, the volt, which denotes pressure, the ohm, which denotes resistance, and the ampere, which denotes quantity. These three quantities are so related that we can say that one volt will force one ampere through a resistance of one ohm. Further, if we know two of the quantities mentioned we can always find the third.

For instance, to find the amperage, where we know the resistance and the voltage, we proceed as follows:

Current = voltage divided by resistance.

$$\text{or } C = \frac{V}{R} \qquad \text{(Equation 1)}$$

or it may be shown:

$C = \frac{E}{R}$ since voltage is usually denoted by "E."

Again, to find the voltage where we

know the amperes and the ohms resistance, we write:

V or E = C × R. (Equation 2)

When the voltage and amperage are known and we desire to find the resistance, use the following equation:

$$R = \frac{E}{C}$$ (Equation 3)

To impress this on your mind work out the following examples:

(1) "Where the voltage is 6 and the resistance is 2 ohms, find the flow of current in Amperes."

Using equation 1 and replacing the letters with the figures of our problem, write:

C = E divided by R

or $C = \frac{E}{R}$ but E is 6 and R is 2 ohms, then

$C = \frac{6}{2}$ equals 3 amperes.

(2) "Where the amperage is 3, and the resistance is 2 ohms, find the voltage." The voltage being the unknown quantity, we use equation 2 and write as follows:

E = C × R, but C equals 3, and R equals 2;

then

E = 3 × 2, or 6 volts.

(3) "When the amperage is 3, the voltage 6, find the resistance." Using equation 3, we write:

$R = \frac{E}{C}$ but E is 6 and C is 3.

then

$R = \frac{6}{3}$ or 2 ohms.

For practice, work out the following questions:

1. How many amperes will flow through a resistance of 6 ohms with an E.M.F. of 9 volts?

2. What voltage will be required to force 15 amperes through 10 ohms resistance?

3. If a coil has 15 ohms resistance what current will flow through it with an E.M.F. of 90 volts?

4. We have a 48 volt battery, and require a flow of 3 amperes in a certain circuit. What resistance will be required to permit this flow of current, disregarding any temperature changes?

NOTE: Too much time cannot be spent working out examples, as the student should be as familiar with the use of ohm's law, as he would be with the handling of his automobile.

Induced Currents

In the previous experiments we have shown how electric current flow can be set up by a battery, also how the motion of a permanent magnet before a coil can set up an electric current flow in the coil and the circuit connected to it. In the following experiments we will endeavor to illustrate how a flow of current in one wire can be transferred to another wire.

Experiment 21

On a table or board about 6 ft. long, stretch two insulated wires, "A" and "B," as shown in Fig. 25, and fasten them with finishing nails or weights, to hold them in position. Where the two wires lie close together, lace them closer with a piece of lacing twine.

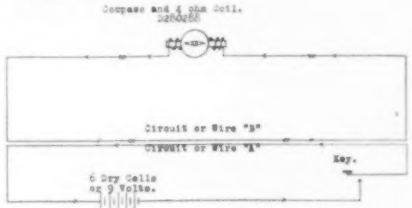


Fig. 25

In circuit A connect 6 dry cells in series, and a push button or telegraph key.

In circuit "B" connect a 4 ohm coil, and lay over the coil the pocket compass used in previous experiments. Those working in Strowger automatic exchanges, can use coil D280288 which is 4 ohms. The coil and compass should be far enough away from circuit "A" to prevent the compass being affected by it.

With the compass needle parallel to the coil, press the key, and observe that the compass swings, say to the right, and then back parallel again. Then open the key, and observe that the compass swings to the left, and then back to parallel, or the zero position.

Now referring to Fig. No. 26, and following the sequence of operations carefully, what has taken place should be understood.

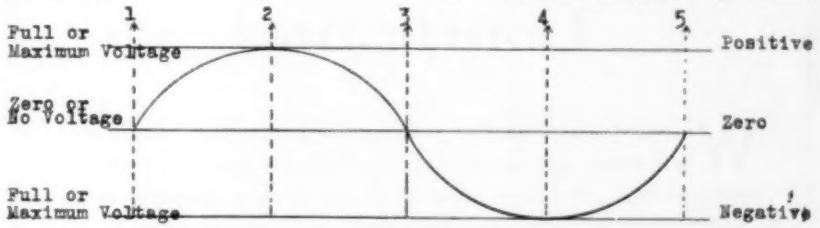


Fig 26

1. Circuit in "A" closed. Battery current flows in one direction and the induced current in "B" is set up in the opposite direction. Current in "B" rises from zero and reaches its full voltage at point indicated by the figure 2.

At 2, circuit in "A" still closed and current is still flowing. The magnetic field of "A" has reached its full maximum, and when it comes to rest, the voltage of "B" ceases to rise further. Immediately the voltage in "B" commences to fall.

At point 3 circuit "A" still closed, and magnetic lines still fully extended, but voltage of "B" has dropped to zero again and remains so as long as "A" is closed. Then "A" is opened, and the magnetic lines thrown out from "A" subside or draw in, and in doing so cut past "B" in the inward direction. A voltage builds up in "B" in a direction opposite to its first voltage, and reaches its highest voltage at point 4.

When all the magnetic lines of circuit "A" have drawn in past "B" and as there is no more magnetic disturbance exchange in the magnetic field, the voltage in "B" will drop, reaching zero at point 5.

We will refer to the first induced current in "B" as a positive alternation. This is from 1 to 3. The section from 3 to 5 we call the negative alternation. From 1-3 is one-half cycle and from 3-5 the other half, and from 1-5 is a complete cycle.

Referring again to Fig. 25, the single arrows indicate the direction of current flow in both circuits when "A" is closed,

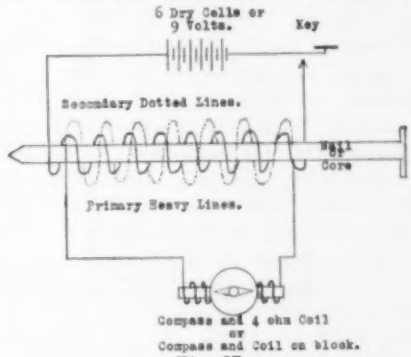


Fig. 27

and the double arrows the circuit in "B" when the circuit "A" is opened again. The currents flowing in "B" in both cases we call *induced currents.*

The induced current is dependent on the magnetic disturbance set up in circuit "A." This is illustrated by referring back to experiments 14-15-16-17-18.

Therefore, if a flow of current in an electrical conductor throws out a magnetic disturbance, then it should follow that a magnetic disturbance around an electrical conductor should cause a flow of current if the circuit of the conductor is closed

Now, it should be quite clear that if we increase the magnetic disturbance, we should increase the induced current. This can be shown in the next experiment shown in Fig. 27.

Experiment 22

Here we have a 5-inch nail over which we wind a layer of 50 turns of No. 22 double cotton covered (D. C. C.) wire, or any convenient size. Put on a layer of friction tape, then wind on 50 more turns

of the same wire. Now connect the coil and magnet in the outer layer, and the 6-dry cells, and key in the inner layer. Press the key and observe that the compass is made to spin around. Compare the motion of the compass with the motion in Fig. 25. The difference is due to the bunching of the wire and the adding of the iron ore. Both these factors have created a more intense magnetic field.

On the nail we have constructed an induction coil or transformer. The inner winding is the primary, and the outer the secondary.

Now on a block of wood 1"x3"x3" wind four layers of small magnet wire, say No. 28 D. C. C., and use in place of the 4 ohm coil. Lay the compass over this block, connecting the new coil in place of the 4 ohm coil D-280288.

Repeat the experiment, closing and opening the key slowly, and note the amount of deflection or motion of the compass. Now wind on another layer of 50 turns, in the same direction as the second layer. You now have 50 turns in the primary and 100 in the secondary, or 50 to 100 turns, which is called a ratio of 1 to 2. Repeat the experiment and observe the increased deflection. More layers in the secondary will give an increasing deflection of the compass. So you can see that we have a voltage changing device in the induction coil.

Induction coils for telephone work are, therefore, made with a few turns of coarse wire in the primary, and many turns of fine wire in the secondary. The greater the difference in the turns of the primary and secondary the greater the voltage difference.

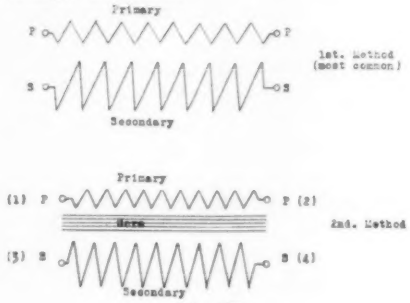


Fig. 28

In Fig. 28 are two conventional methods of illustrating the induction coil.

The Carbon Transmitter

The next device of importance is the transmitter. This is simply a device to control the flow of current through the primary of the induction coil, in unison with the voice of a person speaking into the mouthpiece. Two experiments will illustrate the operating principle of the transmitter.

Experiment 23

In Fig. No. 29 is shown a battery, two protector carbons, and an ammeter, or a battery tester, or better still a milammeter. Wind the wires tightly around one end of each carbon block. Use only one dry cell. With one block laid over the other, vary the pressure with the finger

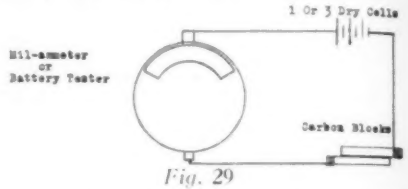
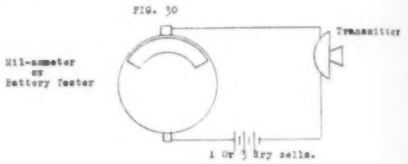


Fig. 29

or a lead pencil, if the carbon gets too hot. Note that with a heavy pressure there was a large reading of the meter, while a light pressure reduced the meter reading.

A light pressure created a high resistance, resulting in a lower current flow. (Check this up by reference to Ohm's Law.)

A heavy pressure reduced the resistance and resulted in a heavier current flow.



Now repeat this experiment, using a standard telephone transmitter. Hold the transmitter in a vertical position and have some one speak different vowel sounds, A E I O U and note the action of the meter. (A good meter should be obtained for this experiment. The Weston Type 269-0 to 25 mil-amperes is best for this purpose.)

The speaker's voice causes the carbon particles in the transmitter to vary their

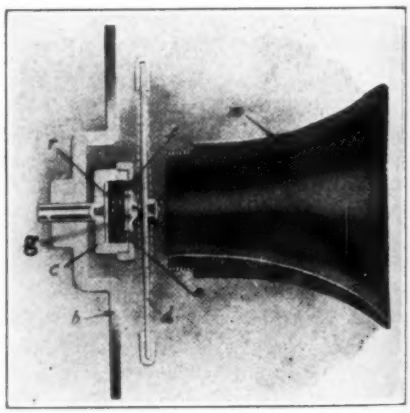


Fig. 31

aMica partition; b mounting bracket; c brass cup; d diaphragm; f front carbon button; r rear carbon button; g carbon granules; m mouth piece.

pressure. The resistance is varied therefore the current flow is varied. (Ohms Law.)

In Fig. 31 is shown the cross section of a modern carbon type transmitter. This is composed of 8 major parts as listed in Fig. 31. The diaphragm is situ-

Financing Telephone Companies

WE specialize in the origination, purchase and distribution of Securities of Independent Telephone Companies. We are prepared to discuss finance and capitalization problems with interested executives.

INQUIRIES INVITED

PAUL C. DODGE & CO.
INCORPORATED
INVESTMENT SECURITIES
10 SOUTH LA SALLE STREET
CHICAGO
Phone: Franklin 6260

Underwriters and distributors of conservative securities suitable for the investment of funds of Banks, Insurance Companies, Estates, Institutions and Individuals

ated with its center directly in front of the mouthpiece. Here the speaker's voice causes the greatest motion, as shown in our first experiments. Bolted to the diaphragm is a polished carbon button, facing into the brass cup "c". This button is shown at "f". The brass cup "c" is solidly mounted to the back "b" and is not affected by the sound vibrations. In this cup is another polished button of carbon "r" facing the button "f". The space between is filled by polished carbon granules "g." Now the only electrical contact between the two buttons "f" and "r" is through the granules "g." A light mica wall "a" keeps the granules from falling out. The space between the buttons is partly filled so that the granules have free movement. Sometimes poor grades of granules will pack or jam and therefore the transmitter is apparently dead. Shaking will relieve this. This trouble is not very common in the best types of transmitters.

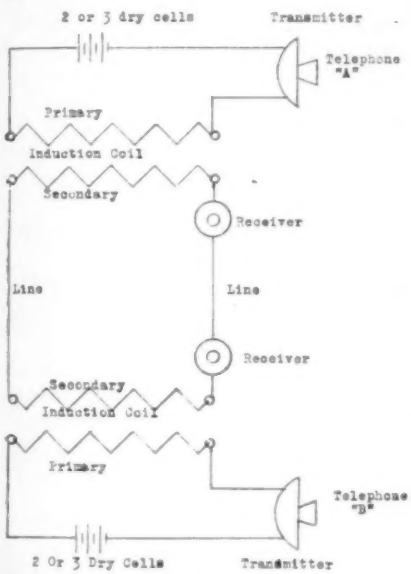


Fig. 32

In Fig. 32 is shown a typical circuit with two transmitters, two induction coils and two receivers connected. By referring to the diagram and the following sequence of operations the action of the telephone using the transmitter and the induction coil will be understood.

1. The speaker's voice at "A" causes the diaphragm to vibrate.

2. The diaphragm causes the front carbon button to move in and out causing a variation in the pressure of the granules.

3. The varying resistance of the granules, varies the flow of current from the battery through the primary of the induction coil.

4. The varying current in the primary sets up a magnetic disturbance which cuts in and out past the secondary turns. This induces an alternating current in the secondary.

5. This secondary or stepped-up voltage travels over the line through the secondary at "B" the receiver at "B," over the line the receiver at "A" to the coil again.

This current operates both receivers.

There is another operation which we seldom consider. The current in the secondary at "B" will naturally cause a magnetic disturbance in the induction coil at "B." This disturbance will be transferred to the primary of "B." Here there is a step down action, and we would find a low voltage current induced in the primary of the induction coil at "B," which flowing through the transmitter and battery is lost.

When "B" speaks the reverse action takes place operating both receivers as before.

Experiment 24

Set up such a circuit as an experiment. Now observe the result of connecting the transmitter and battery at "A" in the secondary, with the primary to the line. It will be observed that the transmission of voice is good in one way only. There are two reasons for this. The induction coil at "A" is stepping down the voltage toward the line, and the increased resistance of the secondary through which the battery must flow to the transmitter at "A" gives a smaller amperage for the "A" Transmitter. (Ohm's Law.)

Check the cost per month —

you'll find RUNZEL-LENZ CORDS are amazing bargains

WE don't usually talk "bargains." In our buying of raw materials we think of price after we've made sure that we are getting the best that can be put into telephone and switchboard cords.

BUT one time when we can offer bargains is when the wise cord buyer does his purchasing on the basis of life of the cord in satisfactory service. Repeated observation under widely varying service conditions reveal RUNZEL-LENZ CORDS as the foremost in durability. When you combine durability with ease of handlng, unexcelled transmission property and reasonable first cost, then you have something worth getting.

GET IN TOUCH with RUNZEL-LENZ, the country's veteran cord specialists, about your cord requirements.

RUNZEL-LENZ ELECTRICAL MFG. CO.

Quality Cords for all Telephone Company Uses

1751 N. WESTERN AVE. CHICAGO, ILL.

George R. Fuller, Pioneer Leader, Dies at Rochester, N. Y.

Rochester, N. Y.—George Riley Fuller, president of the Rochester Telephone Corp. and long one of the leaders in Independent telephone activities, died here May 7 from a heart attack which had kept him confined to the Genesee hospital for six weeks. He was in his seventy-eighth year.

Mr. Fuller was born at Messena, St. Lawrence county, New York, of stock that traced a Mayflower connection to Miles Standish, famous military leader of Plymouth colony. He received a public school education at Norwood, N. Y. This was his only formal education, the rest of his wide learning having been acquired as a result of his fondness of reading.

The first business connection Mr. Fuller had was with a railroad which later became part of the New York Central system. He became a telegraph operator with this road and later, after having been assigned to the road's auditing department, became traveling auditor.

In 1876 Mr. Fuller came to Rochester and purchased a company engaged in the manufacture of artificial limbs. He was president of this organization, The George R. Fuller Co., to the time of its death and as a result of his business genius and industry built it into a company having four manufacturing branches and a big international business.

In 1898 Mr. Fuller became one of the organizers and the first secretary and treasurer of the Rochester Telephone Company, assuming in addition the duties of general manager in the following year. During the years 1905, 1906 and 1907 he had charge of interests of the Independent Telephone Company in western and central New York.

On August 1, 1921, the Rochester Telephone Company was merged with the New York Telephone Company, forming the Rochester Telephone Company Corporation, of which Mr. Fuller since served as president and director.

He was a former president of the Independent Pioneers' organization and of the Up-State Telephone Association of New York. At the time of his death he was serving as a director of the United States Independent Telephone Association. His other business connections in the telephone industry and in local banking and industrial institutions, while extensive, were given the benefit of his able counsel and effort. For the past several years he was, to use his own words, "taking it easy," but still was present at national conventions and other meetings of telephone men where he always was one of the most welcome and genial of the old guard who were responsible for Independent telephony.

Mr. Fuller married Miss Helen Gregg, June 3, 1885, and of this union his two surviving children, George Gregg Fuller and Mrs. David M. Hough, were born. George Gregg Fuller has been in consular service for some time and now is vice counsel at Berlin.

The entire telephone industry mourns the passing of this splendid gentleman and able business man who never failed when there was work to be done or a friend to be helped.

Moore Michigan Properties Are Increased

Caro, Mich.—Telephone plants at Caro and Wahjamega have been taken over by the Moore Telephone System. Financing and an expansion program is being planned. W. J. Moore, the head of the enterprise, has been in continuous control of a telephone property ever since the introduction of telephones in Michigan.

Baird, Tex.—Home Telephone and Electric Co. contemplates work at an early date that will call for cross arms, lightning arresters, booths, branding tools, cable racks, operators' chairs, coils, creosoted wood conduit, financing, lockers, pay stations, pins, pole pullers, reels, trailers and copper wire.

Shelbyville, Mo.—Fire caused $5,000 damage at local telephone exchange.

Kimball, S. Dak.—H. C. Steckleberg, former manager of exchange at George, Ia., has purchased local telephone company.

Muskegon, Mich.—W. E. Hutchens, for 24 years traffic superintendent of the Michigan Home Telephone Co., has been made general manager.

New Hotel Eitel
Chicago
The Next Time You Come
to Chicago make your visit a splendid success by stopping at this beautiful new hostelry.
Room and Bath, 1 person —$3.50, $4, $4.50, $5
Each additional person, only $1
Room and Bath, twin beds—$6, $7, $8
Under the personal supervision of ROBERT J. EITEL and MAX EITEL
Delaware Place at Rush St.
Just a few blocks from the Loop

STEEL HOTEL SETS

Complete and Tested

Dean Electric Co.
straight line $2.50
Harmonic ringers ... 3.00

Stromberg - Carlson (flush transmitter)
straight line 2.50
Harmonic ringers ... 3.00

Stromberg-Carlson (adjustable transmitter),
straight line 2.50
Harmonic ringers ... 3.00

Western Elec. Co., 1000, 1600 or 2500 ohm..... 6.00

Above telephones completely refinished — $1.50 extra.

Buckeye Telephone & Supply Company

Columbus, - - Ohio

BRIDGING twisted pair to twisted pair, a practical application of the Kearney Solderless Service Connector.

FOR Telephone Lines in making party line taps, order Catalog No. 86. The tap can't slacken off. This connector is for No. 12 wire or smaller.

ASK ABOUT KEARNEY CERTIFIED MALLEABLE SCREW TYPE ANCHORS

Kearney Guy Wire Serving Clips. Eliminate Serving End of Strand. Made of Aluminum, Copper, and Galvanized Iron.

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

4226M Clayton Ave.

Over Half a Million in Use

VacuumGrip PLIERS

REG. U.S. PAT. OFFICE

Lineman's Pattern No. 58, 8½ in. $3.50. Also furnished in 6 and 7 in.

Your Name Etched FREE on Handle

Sheer BRUTE STRENGTH!

PLIERS have to be mighty good these days to stand the "gaff." Correct design, cutting ability, easy-working joints, etc., are not enough. They must have sheer "brute strength."

When you go after a tough job of twisting, gripping, cutting or hammering, or when you drop them from a pole, you expect them to do their work—without breaking.

We believe VACUUM GRIP Pliers will give you a new idea of plier strength. Of course, they're forged from electric furnace tool steel, hardened and tempered thru and thru, NOT Case-hardened. But the thing you are interested in is what they will do for *you*.

A running test will answer that question. Let us send you a pair or two for trial. If you are not pleased with them the purchase price will be refunded.

VACUUM GRIP Pliers are Guaranteed to give absolute satisfaction to the user, or full replacement or refund of purchase price will be made

Write for Catalog T-5 describing over 35 sizes and patterns, including special designs for repairmen and switchboard use, from which to select samples for trial.

PURCHASING AGENTS: Send for samples for your men to test

FORGED STEEL PRODUCTS CO., Newport, Penna.

For Maximum Service—Baker Contact Points

DEPENDABILITY and long life are the two essentials in a contact point. This "heart of the machine" should function evenly and steadily over long periods of time—it should not need replacement at frequent intervals.

Baker Contact Points are made with this principle always in mind and the name "Baker" assures that perfect performance, without constant renewal, which is the outstanding characteristic of a *good* contact point. Our contacts are made of Platinum, Iridio-Platinum, Silver and Special Alloys. There are sizes and types for all purposes.

BAKER & CO., INC.

54 Austin St., Newark, N. J.

NEW YORK CHICAGO

"Fan" Types for Telephone Work

THE Weston "fan" shape group effectively meets problems of adaptability, as in their various sizes they have the widest scales, and in addition they possess the inherent Weston characteristics of precision and dependability. ¶ The Weston "fan" shape group is made in four sizes as D. C. Voltmeters and Ammeters (Models 267, 269, 271 and 273) in a comprehensive list of ranges with scales from 2.5 inches to 7.6 inches in length.

Weston Electrical Instrument Corporation

198 Weston Avenue,

Newark, N. J.

STANDARD THE WORLD OVER

WESTON

Pioneers since 1888

Wind Shield Insures Efficient Operation in all Kinds of Weather.
Patented Large Non-Heating Valve Wheel
Removable Burner Block Orifice cannot be enlarged
Patented Furnace Type Burner, Greater Heat and Continuous Operation
Easily Removable Needle Cleans Burner Orifice Every Time Valve is Opened or Closed
Clevis
Large Pressed Steel Drip Cup Brazed to Supply Pipe
Angle Handle Restful and Easy to Hold
Filler Plug on Top Easily Filled No Chance for Dirt to Enter
Handle Support Does Not Extend Through Tank
Pump Has Double Check Valve. Second Held in Place by Clevis
Flared Base for Greater Stability
Steel Tank with Bottom and Three Connections Only Brazed. Every Tank Tested to 100 lbs. Pressure
Three Thicknesses of Steel Where Greatest Wear Takes Place

LOOK INTO THIS NEW WALL

DREADNAUGHT

This new steel torch combines all the advantages of the time-tried older Dreadnaughts with a number of improvements. Built for heavier work, to give a bigger, hotter flame. New burner cleans itself automatically. All joints brazed with hard brass spelter solder; every torch tested. Can be used in all kinds of weather. A better "service with safety" torch that has been adopted by many of the largest public utility companies. Let us tell you more about the new Dreadnaught No. 41.

P. WALL MFG. SUPPLY CO.

3126-66 Preble Ave., N. S. Pittsburgh, Pa., U. S. A.

Since 1864

Announcing—
the Highway Earth Boring Machine
Bores the Hole--Sets the Pole
A pole in the ground every five and one-half minutes is the record recently made on new line construction—under actual operating conditions. A three-man crew with the Highway Earth Boring Machine and Pole Setter bores the holes, sets the poles and moves from position to position all in this remarkable time. A saving of 75% of the time required for the same work by any other method.
The machine mounted on a Fordson or International Harvester tractor, equipped with crawlers, negotiates steep grades and swamps and easily reaches ninety percent of all locations.
Write for complete nformation
HIGHWAY TRAILER COMPANY
EDGERTON, WISCONSIN

Hotel Empire

BROADWAY at SIXTY-THIRD ST.,
NEW YORK CITY

A New Fourteen Story Fireproof Structure Containing the latest in Furnishings and Equipment.

Capacity 1034

The Location is Unique in the Heart of the Automobile District, with Subway, Elevated Street Cars, Busses---all at door.

RATES

Room, Private Toilet	$2.50
Single Room with Bath	3.50
Double Room with Bath	5.00

M. P. MURTHA, General Manager *Ample Parking Space*

Bigger Business Puts Automatic Coil Winder in New Home

London, Eng.—The Automatic Coil Winder and Electrical Equipment Company's increasing business has made it necessary for the organization to move into a larger plant at Winder House, Rochester Row, London, S. W. 1. In addition to Automatic's big business in coil winding equipment the company is going into coil winding work and the repair of transformers, loud speakers, headphones, etc., on a more extensive basis.

St. Marys, Ga.—St. Marys-Kingsland Telephone Co. has been bought by Frank Bailey.

Walter McLean, Illinois Phone Man, Is Honored

Hillsboro, Ill.—Walter McLean, secretary of the Peoples Mutual Telephone Co., was elected chairman of the Montgomery county board of supervisors, without opposition. This is the first time in 33 years the office has gone to a Republican.

Contact Metals Moves to New Chicago Plant

Chicago, Ill.—Contact Metals Co., buyers of scrap platinum, has moved to its new headquarters at 2500 South Wabash avenue, Chicago.

Vermont Slates Convention for June 14-15, Burlington

Burlington, Vt.—The seventh annual convention of the Telephone Association of Vermont will be held at the Van Ness House, Burlington, Tuesday and Wednesday, June 14 and 15. C. L. Ovitt, Enosburg Falls, is secretary of the organization.

Road Map Advertises Missouri Company

Butler, Mo.—A road map of its territory is being distributed with splendid advertising results by the Missouri Union Telephone Co. at Clinton, Mo. "Booster" advertising for Henry county is carried on the back of the map.

LINE AND DESK

A SUPERVISORY LAMP PROBLEM

The following problem involving resistances in various portions of a certain switchboard circuit is submitted for our answer:

Figure "A" shows the sleeve circuit of a standard W. E. Co. No. 1 cord circuit having no sleeve relay. I wish to use, however, a circuit on the order of figure "B." Besides the addition of a sleeve relay you will note an increase of the jack-sleeve resistance from 34 to 50 ohms. I have had a little difficulty in selecting a lamp for the circuit, but from

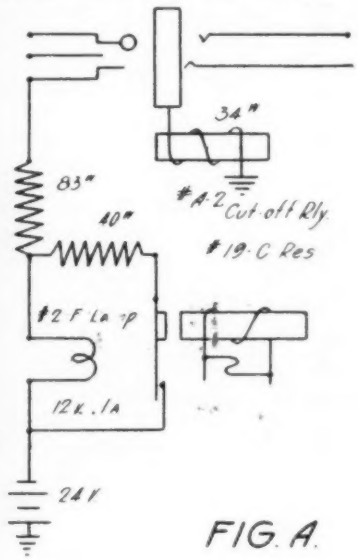


FIG. A.

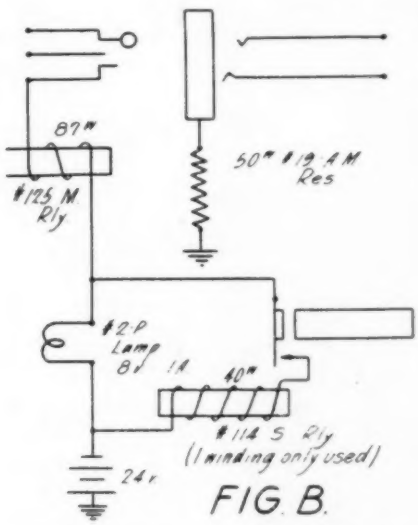


FIG. B.

the information given below I have decided that the W. E. Co. No. 2-P lamp will do the work. From the information below, will you please advise me of any difficulty you believe I might encounter—in the complete extinction of the lamp when shunted, etcetera?:

Operating current No. 125-M relay—.086 amp.

Operating current No. 114-S relay—.094 amp. (.047 amp. with both windings series aiding.)

Current for No. 2-P 8-volt lamp—Max., .10; Min., .085 amp.

Current for No. 2-F 12-volt lamp—Max., 12; Min., 097 amp.

Difficulties which may arise in the operation of circuit B if the resistances in various portions of the circuit are not correctly proportioned are as follows:

1. 125-M relay may not operate when plug is inserted.

2. Lamp may be over-bright or too dim.

3. 114-S relay may not operate.

4. Lamp may burn dimly when shunted by 114-S relay, giving dim disconnect signal.

5. Excessive current may flow in relay windings when lamp is shunted, causing overheating or possibly slow release of relay 114-S in case of flash signal.

A computation of the current in the various portions of the circuit will throw some light on the possibility of these conditions when considered along with the information supplied in the query. The current has been computed for conditions in Fig. A and in Fig. B, both with the 8 volt lamp suggested and with a 12 volt lamp of the type used in Fig. A. The results are given in the following table:

Circuit condition.	Fig. A. Amp.	Fig. B. 8 v. lamp. Amp.	Fig. B. 12 v. lamp. Amp.
Current through lamp unshunted	.1	.109	.092
Current through lamp shunted	.04	.049	.036
Current through 125-M relay with lamp unshunted.... ...		.109	.092
Current through 125-M relay with lamp shunted..... ...		.148	.142
Current through 114-S relay with lamp shunted..... ...		.098	.108

From these figures it will be seen that difficulty No. 1 will not be probable in the circuit proposed as the operating current is in excess of the .086 amp. specified. Using the 8 volt lamp which is designed for a maximum current of .1 amp. might result in a rather shorter than normal life of the lamp due to the fact that the current is in excess of that specified as the maximum. Using the 12 volt lamp, the brightness might be slightly below normal as the current would be .008 amp. below the normal rating and .005 below the minimum rating.

There should be no difficulty in the operation of the 114-S relay from excessive current in either case, but it will be noted that the 8 volt lamp will have nearly 50 per cent of its rated current flowing when it is shunted by the 114-S relay winding. This will result in a dimly lighted filament, but whether it will be noticeable through an ordinary lamp cap can only be told by trial. The 12 volt lamp would not be noticeable through a lamp cap.

If the calculations are repeated using a lamp rated at 10 volts and .1 amp. it will be found that the current through the lamp both in the shunted and the unshunted conditions would be almost identical with the current in the original circuit of Fig. A.—Staff contribution.

A DIVIDED CIRCUIT RINGING PROBLEM

A southern subscriber submits the following questions relative to a party line ringing problem:

1. Will two party service using the divided circuit work successfully with magnetic equipment?

2. On a dividend circuit, magneto equipment, can station No. 1, signal central office without ringing bells on station No. 2?

3. If low wound drop coils are necessary for this service, what resistance coil should be used?

4. What resistance ringer coils on party stations are necessary for this service?

5. What resistance generator for this same service?

We have the following suggestions to make:

1. We know of no reason why two-party service can not be given by the use of the divided circuit for selective ringing.

2. Station No. 1 can signal the central

office without ringing station No. 2, provided that the generator is equipped to disconnect its own bell from the line while the crank is being turned, i. e., is equipped with the so-called silent ringing scheme.

3. Low wound drops are usually recommended, say 200 ohms.

4. The ringer coils may be any standard resistance for bridging service, 1,000 ohms or more.

5. It is preferable that a weak generator be used, that is, a two or three bar generator, which will be ample to ring down the central office drop and yet will be less likely to ring across to the other station on the line.

Our own personal experience with the use of divided circuit ringing is confined to common battery service and we are hoping that some of our "pinch hitters" who are always willing to give their experience may come to bat with other suggestions or corrections if we are wrong in any of our answers.

NUMERICAL COMPUTATIONS FOR VOLTMETER RESISTANCE SCALE

Following the discussion in the April number of TELEPHONE ENGINEER, the following is contributed to illustrate the application of the principles outlined in the previous contribution:

The values used in the computations and graphs are selected only to demonstrate the necessity of using the proper method, for the measurement given. In case one the known resistance drop method is used and in case two the unknown drop. It is obvious, from the graph, that case one will be more accurate for lower and case two for higher ohmic values. Case one affords more minute ohmic values per unit deflection and case two the greater ohmic values.

Case One

$R = (E - E_1/E_1) R_1$.

Voltmeter resistance—10,000 ohms.

Known resistance—526 ohms.

Joint value or R_1—500 ohms.

Test battery voltage—60 volts.

E_1 readings—42-37-30-28 v.

(1) $R = (60 - 42/42)\ 500 = 214$ ohms.

(2) $R = (60 - 37/37)\ 500 = 311$ ohms.

(3) $R = (60 - 30/30)\ 500 = 500$ ohms.

(4) $R = (60 - 28/28)\ 500 = 571$ ohms.

Case Two

$R = (E - E_1/E_1) R_1$.

Voltmeter resistance—10,000 ohms.

Test battery voltage—60 volts.

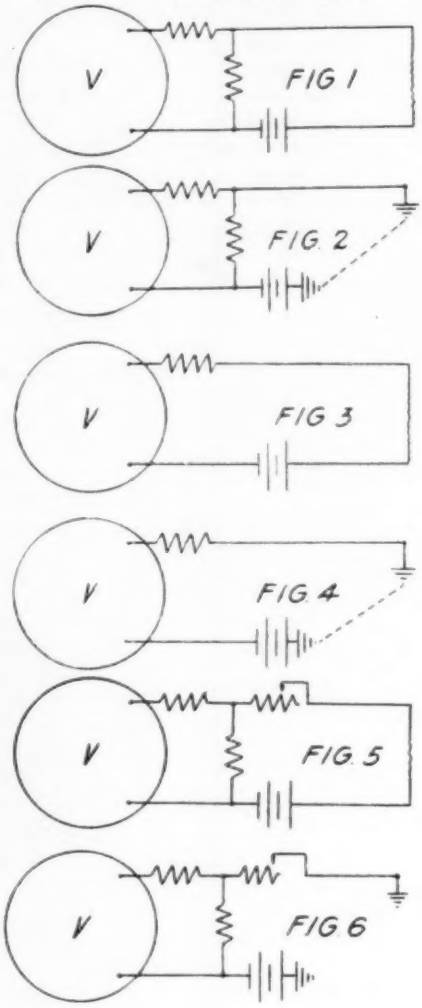
E_1 readings—55-50-45-30 v.

(1) $R = (60 - 55/55)\ 10000 = 909$ ohms.

(2) $R = (60 - 50/50)\ 10000 = 2000$ ohms.

(3) $R = (60 - 45/45)\ 10000 = 3333$ ohms.

(4) $R = (60 - 30/30)\ 10000 = 10000$ ohms.



The most accurate ohmic values, however, are obtained when the external resistance equals the resistance of the voltmeter circuit and at that point $2E_1 = E$ and the current causing the deflection is exactly one-half of the full deflection current. The method in Fig. 5 applies this fact and up to the ohmic limit of the resistance box offers a direct reading method.

The external resistance is equal to the resistance of the voltmeter circuit when $2E_1 = E$.

Proof:

$$R = (E - E_1/E_1)\ R_1$$

and

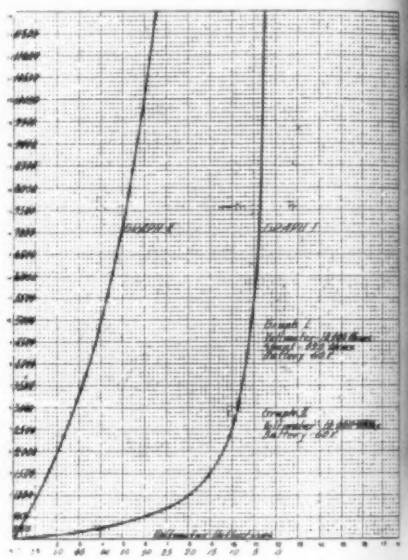
$$E = 2E_1$$

sub.

$$R = (2E_1 - E_1/E_1)\ R_1$$

then

$$R = (E_1/E_1)\ R_1 \text{ or } R = R_1.$$



The resistance box is adjusted until $E_1 = E/2$.

Deduct the resistance indicated by the resistance box from that of the voltmeter circuit and the result is the measurement desired.

Example

Test battery voltage—90.

Joint resistance of voltmeter and known

To Reach the Man
Who Does the Buying
Advertise
in
TELEPHONE
ENGINEER

Public Utility Financing

P. W. CHAPMAN & CO., INC

170 W. Monroe St. Chicago
42 Cedar Street New York

Boston Albany St. Louis Milwaukee Grand Rapids
New Orleans Seattle Portland San Francisco

resistance—1000 ohms.

Resistance indicated by box when $E_1 = E/2 - 200$ ohms.

$1000 - 200 = 800$ ohms = external resistance.

—Contributed by R. E. Johnson.

American Announces New P. B. X. Boards

Chicago, Ill.—American Electric Co., Inc., has just recently completed the development of two new-type Monarch P. B. X. switchboards that are standardized as to equipment, design and operation and should meet the requirements of the most exacting telephone company. This standardization of boards is developed to such a degree that they can be operated with either common battery manual or automatic service.

Monarch 30—Line P. B. X. Switchboard of either the standard or feature type. May be equipped with dial

These boards are grouped into two classes: One is known as the standard P. B. X. switchboard; the other as the feature P. B. X. switchboard.

The feature P. B. X. switchboard contains all of the features of the standard swithboard as well as many others that provide special operating and trunk requirements desired by some operating companies.

Both the standard and feature P. B. X. switchboards will be built in two sizes—30-line and 80-line. Each size will be carried in stock by the American Electric Co., Inc., in three capacities, and can be operated with or without dial, according to the type of city equipment.

Larger boards of any capacity desired can be furnished having the same features and requirements as these standardized smaller P. B. X. switchboards. Standardization of P. B. X. switchboards of both the equipment and traffic standpoint is obtained with these switchboards. The various operating features of these two boards are interchangeable according to the requirements of the different types of exchanges, but the mechanical construction is common to both.

The following are some of the principal features of the standard feature P. B. X. switchboards:

The station and exchange trunk circuits are terminated on answering jacks, with which are associated the corresponding lamp signals.

Double-ended connecting cords are provided for setting up connections. Through relay control, these cord circuits adapt themselves to either station-to-station, station-to-trunk or trunk-to-station service.

Lamp supervision is provided in the cord circuits.

Talking battery is supplied from the P. B. X. battery source except, when the through calling or night service key is thrown, the battery for the P. B. X. station is furnished from the exchange trunk source.

When the through dialing key is operated, the cord circuit is set for the following classes of special services: (a) Through dialing; (b) long distance connections (optional operation); (c) night connections.

Placing of all calls is under the supervision of the P. B. X. operator, while the through calling key is thrown.

All feature boards are provided with trunk recall.

Non-ring through supervision can be arranged for with the feature P. B. X. switchboards if desired.

For night service no extra patching coards or special night jacks are required.

Special night group jacks are provided for use when several stations are to be connected to a single trunk for night service.

Great care has been taken to prevent unnecessary operation of relays, and the windings are designed to give maximum efficiency with minimum current drain.

Full information regarding the operation and design of these boards may be obtained from the American Electric Co., Inc., Chicago.

Lewisburg, Pa.—Buffalo Valley Telephone Co. buys Lewisburg Bank building for its new headquarters.

Legion Song Result of Telephone Co-operation

Lincoln, Neb.—Dean Crary, commander of the Belleau Wood Post No. 278 of the American Legion at Guide Rock, Neb., has the honor of being the state's pioneer in transmitting a musical composition over telephone wires to W. M. Johnson of Kansas City, Mo., well known composer of music, for arrangement. The Lincoln Telephone and Telegraph Company is highly elated over the success of the enterprise. Mr. Crary recently composed a song which will be submitted, as the official state song to be used by the delegation on the pilgrimage to the National Convention in Paris this fall.

Legionnaire composer finds phone help

"Hello," House Organ Is Issued by Interstate Utilities

Spokane, Wash.— "Hello," a highly interesting little house organ, made its bow with the February issue. The Interstate Utilities company is sending it free to its subscribers. The contents of the first issue include an advertisement on desk and wall type monophones, bearing the display line "You have seen them in the movies; now you can have one in your home," a coupon good for 15c on a long distance call or night letter, and many personal stories containing commendation and criticism of the service, as well as news of the company's personnel.

The first issue features announcement of a prize contest offering $15 to the subscriber who writes the best article of 200 words or less on "when my telephone was of most value to me."

Oil City, Pa.—A. W. Hayes, Erie, has been elected president of the Petroleum Telephone Co., succeeding Frank McMasters, deceased.

UNIQUE
BLOW TORCH

It starts quickly, operates in any position, and produces a remarkable heat. It is a great worker in cold and windy weather.

The automatic orifice cleaner, one of the details shown in the illustration, is but one of a number of exclusive features that make the Unique your greatest value in blow torches.

Painstaking care by interested workmen, an actual "burning test" before shipping, is just another detail responsible for their uniformity and efficient burning qualities.

Write for complete details

Unique Manufacturing Co.
221 Whiting St. CHICAGO, ILL.

Everstick

Approved by Large Operating Companies For the Following Strains

6" 2-way	2,200 lbs.
6" 4-way	6,000 lbs.
8" 2-way	6,000 lbs.
8" 4-way	10,000 lbs.
10" 4-way	16,000 lbs.

Write for Details

Everstick Anchor Co.
ST. LOUIS, MO.

CHOICE NORTHERN
WHITE CEDAR POLES
LET US SERVE YOU ALSO
REPUBLIC CEDAR CO.
MARINETTE WISCONSIN

Joseph V. Smith Is Coast Hubbard Manager

Oakland, Cal.—Joseph V. Smith, formerly General Manager of the shovel interest of Hubbard and Company, Pittsburgh, has been appointed Pacific Coast Manager for the electrical materials department of this company with headquarters at the Oakland plant.

Mr. Smith has had a very broad experience in the manufacturing field. He

Joseph V. Smith

started his career with Oliver Brothers, Inc., as an office boy in the New York office and worked for this company for sixteen years, becoming manager of the Pittsburgh office in 1910. In 1915 he joined the firm of Hubbard and Company as General Manager of the shovel department.

He has now moved to the coast and taken up his new duties as Coast Manager for the electrical materials department, directing production and sales of Hubbard pole line hardware and Peirce construction specialties. Sales on the Pacific Coast will be made exclusively through the Hubbard Coast distributors, Pacific States Electric Company and Graybar Electric Company, Inc.

St. Louis, Mo.—The constituent companies of the Scotia Telephone Co., for which P. Kerr Higgins, of 6330 Alamo avenue, St. Louis, is the head, send us the following field reports:

Festus, Mo.—Will erect over a mile of new cable. In the market for a common battery switchboard and C. B. instruments, main frame, etc.

Jefferson County—Will make all lines metallic and may install one or more automatic units. In the market for iron wire, poles, hardware, etc.

Washington, Mo.—Will erect over a mile of new cable.

Versailles, Mo.—Will erect new cable and bury in earth.

Puxico, Mo.—Will rebuild toll lines.

Kilpatrick and Robinson Advanced at New York

New York City—On May 1st a new officer, vice-president in charge of operation, will be added to the general executive staff, to whom the general managers of each of the operating areas will report.

Effective June 1 the territory which is now served in three divisional areas—New Jersey, downstate and upstate New York—will be still further divided by the separation of Brooklyn and Queens Boroughs and Suffolk and Nassau counties from the present downstate area, to form a new area, Long Island.

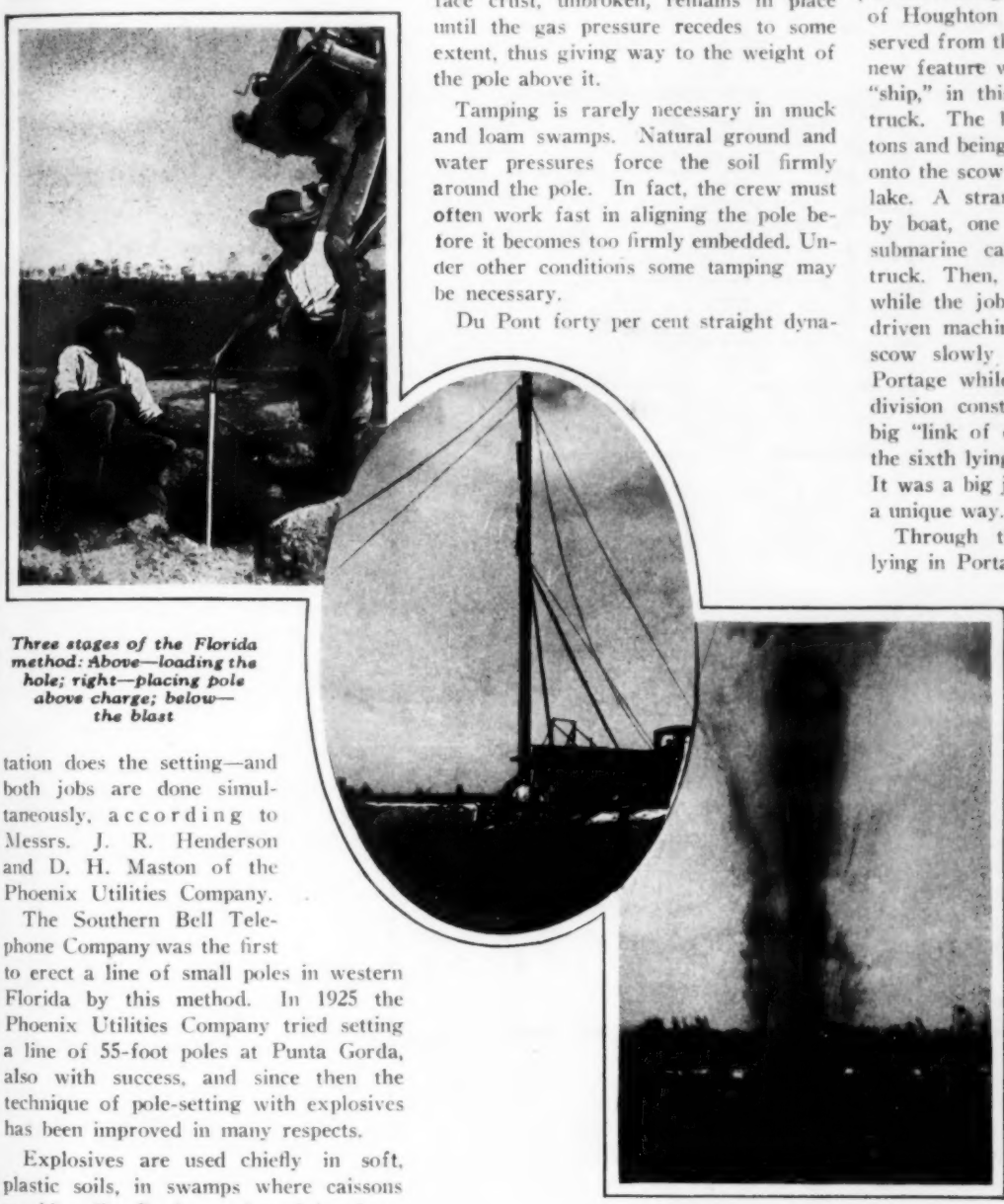
James L. Kilpatrick, who will become the new vice-president in charge of operation on May 1st, was born in Philadelphia and began his telephone career on the first day of the twentieth century—January 1, 1900—in the plant department of the Bell Telephone Company of Pennsylvania. For twenty-two years Mr. Kilpatrick continued with that company serving in various capacities of increasing importance in the plant and engineering departments. His last position with that company being assistant vice-president and general manager. On November 1, 1922, he was made general manager of the installation department of the Western Electric Company with headquarters in New York. On January 1, 1925, he was elected vice-president and director of the Western Electric Company, responsible for installation work and commercial activities, which position he now holds. Mr. Kilpatrick lives in East Orange, N. J.

In charge of the new Long Island area as general manager will be J. J. Robinson, at present the general plant manager downstate for the New York Telephone Company. Mr. Robinson, after leaving the Brooklyn Manual Training School, entered the telephone service in 1899 in New York City. In 1907 he was made supervisor of plant work in the Long Island division of the old New York and New Jersey Telephone Company. In 1912 he was made superintendent of plant for the Bell Telephone Company of Missouri. Subsequently he became general plant superintendent of the Michigan State Telephone Company at Detroit, then general plant manager for the Southwestern Bell telephone system with headquarters at St. Louis. On March 1, 1924, he was made general plant manager of the New York Telephone Company and returned to this city where he had started his telephone career a quarter of a century earlier. Mr. Robinson lives in Hempstead, Long Island.

Chicago, Ill.—Corn Belt Telephone Co., operating exchanges at Atlanta, Armington, McLean, Heyworth, Downs, Leroy, Saybrook and Bellflower, has been bought by Central City Telephone Co., W. H. Winston, president, of Chicago.

Shovel Bows to Dynamite in Florida

For a half century the orthodox method of building telegraph and telephone lines has been to dig holes and then plant poles. When explosives are used, the order of work is reversed. At least that is true in the swampy sections of Florida where the use of hand shovels and digging machines is impracticable. There dynamite does the digging, gravitation does the setting—and both jobs are done simultaneously, according to Messrs. J. R. Henderson and D. H. Maston of the Phoenix Utilities Company.



Three stages of the Florida method: Above—loading the hole; right—placing pole above charge; below—the blast

The Southern Bell Telephone Company was the first to erect a line of small poles in western Florida by this method. In 1925 the Phoenix Utilities Company tried setting a line of 55-foot poles at Punta Gorda, also with success, and since then the technique of pole-setting with explosives has been improved in many respects.

Explosives are used chiefly in soft, plastic soils, in swamps where caissons would ordinarily be used, and in places where poles must be set deep under water.

The method is simple. A hollow drill pipe—usually 1½ inch diameter—is driven vertically to the required depth, the soil being forced out at the bottom with a ram. The explosive charge, primed with an electric blasting cap, is lowered through the pipe to the bottom, whereupon the pipe is removed and the charge is ready for shooting.

Next, the pole is raised to vertical position with its butt on the ground directly over the charge. Small poles are supported in place with pike poles; large poles, with four-way rigging. And then the charge is set off. The blast creates a gas pocket and the pole drops into it as the gases escape around its sides. Sometimes there is a lapse of a few seconds before the pole drops. The surface crust, unbroken, remains in place until the gas pressure recedes to some extent, thus giving way to the weight of the pole above it.

Tamping is rarely necessary in muck and loam swamps. Natural ground and water pressures force the soil firmly around the pole. In fact, the crew must often work fast in aligning the pole before it becomes too firmly embedded. Under other conditions some tamping may be necessary.

Du Pont forty per cent straight dynamite is the explosive used, the charges varying in amount with soil, pole-depth and other conditions. The following table is a résumé of opinions from superintendents and foremen who have had experience in such work:

No. of Sticks	Type of Soil	Depth of Hole (feet)
2½....	Swamp, muck underlying	6 to 7
3	Swamp, muck and rock underlying..	6 to 7
3	Sand and water....	7 to 7½
4 to 5..	Ojus rock (Native South Florida)...	6 to 7

Poles as long as 110 feet have been set successfully by this method in holes from 14 to 16 feet deep. Many pole lines have been so constructed throughout Florida.

A NEW STUNT IN LAYING SUBMARINE CABLE

A rather unusual method of laying submarine cable is described in a recent number of "The Mouthpiece." The job refers to the placing of a new cable across Portage Lake connecting the cities of Houghton and Hancock, Mich., both served from the Houghton exchange. The new feature was by hauling of the cable "ship," in this case a large scow, by a truck. The big cable, weighing eleven tons and being 1,400 feet long, was loaded onto the scow at the Hancock side of the lake. A strand cable was taken across by boat, one end being hitched to the submarine cable and the other to the truck. Then, with all boat traffic halted while the job was being done, the gas-driven machine pulled away, towing the scow slowly across the waters of old Portage while Lyman Green's Northern division construction crew paid out the big "link of communication" that makes the sixth lying on the bottom of the lake. It was a big job, even if accomplished in a unique way.

Through this and the other cables lying in Portage lake, not only Hancock, but Hubbell, Lake Linden, Calumet, Laurium, Osceola, Ripley, Ahmeek, Allouez, Mohawk, Eagle River, Eagle Harbor and other towns get their toll and long distance connection with Houghton and more distant points. Hancock also receives its local service through these cables. The new cable contains 408 pairs of wires for local service and 46 pairs for toll and trunk line service. It is protected by coverings of jute, gutta percha and steel armor.

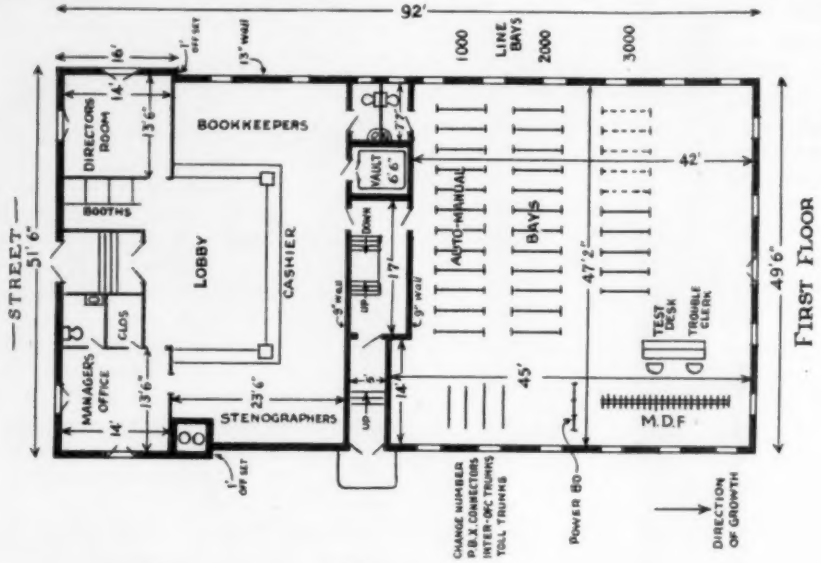
Waco, Tex.—R. W. Garner, plant superintendent of Texas Telephone Co., and Hal H. Cox, former Texas general superintendent and now of Diversified Investments staff, honored on completion of 30 years' service in telephone industry.

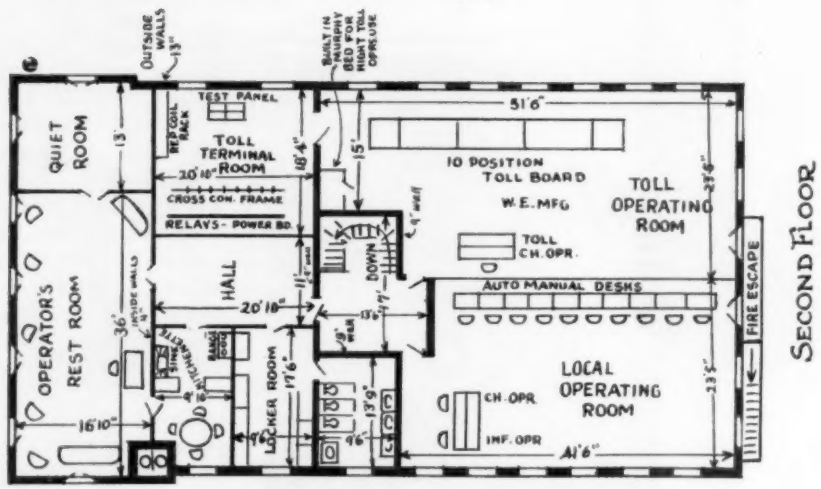
Starbuck, Minn.—Starbuck Telo. Co., A. H. Dreyer, mgr., to erect new headquarters building.

Bowen, Ga.—Bowen Telephone Co. has bought Ashburn Telephone Co. and plans $12,000 program of improvement.

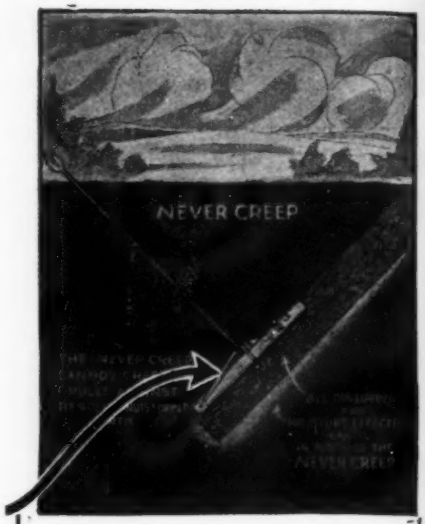
Ashtabula's New Home Is One of Ohio's Prizes

Ashtabula, O.—Late in 1926, the Ashtabula Telephone company completed its move into its new building which is one of the most modern telephone buildings in the state. It is designed especially to accommodate the automanual equipment which is in use to serve 5600 telephones in Ashtabula and Ashtabula Harbor. The building is of the Georgian Colonial period covering a ground area of 92′x51′6″ with two stories and basement. It is built of red brick with limestone trimming, the front entrance being all limestone.





The first floor provides space for the general offices of the company with a spacious lobby, bookkeepers' and stenographers' rooms and a pleasant office room for Manager J. D. Bonnar. In the rear is a large room approximately 45 feet square which houses the automanual switching equipment. The second floor provides space for the automanual desks in the local operating room and a toll operating room for the Ohio Bell Telephone Company, which operates serving 500 lines of new equipment were installed in the new office. These were then cut into service and five bays of equipment in the old office were then cut out of service and the equipment transferred to the new building. The equipment was thoroughly cleaned and then the cables were attached and soldered making the equipment ready for service. Lines were then transferred to the equipment and another section was vacated and moved. As there are two thousand lines in service on the main exchange four changes were necessary to transfer the entire equipment which was reassembled in such a way that it was not necessary to make changes in telephone numbers.



In *Any* Soil

Never-Creep Anchors

Have Superior Holding Power

In sandy, moist, adobe, or any other soils, the great holding surface of the NEVER-CREEP and its pull against solid, undisturbed earth gives an anchorage that is unsurpassed.

The more you look into anchor construction and performance the more you realize that undisturbed earth to pull against is a vital consideration. Tamping very seldom suffices to give the holding condition an anchor needs. Moisture seeps down to the holding plate of the anchor and collects there with a great sacrifice of the anchor's rigidity. You know how these factors ruin holding power, so play safe by standardizing the NEVER-CREEP and get away from the perils that are bound to come when the earth is disturbed during anchor installation.

The NEVER-CREEP alone has the Thimbleye rod.

Foremost wire companies prefer the NEVER-CREEP. So will you when you learn its complete story. Write us for details.

Chance Company
Centralia, Mo.

Made in Canada by
N. SLATER CO., INC.
Hamilton, Ont.

Frenzied Finance Rapped at Pennsylvania Meeting

Harrisburg, Pa.—Frenzied financing of telephone companies was subjected to an enlightening denunciation by G. W. Robinson, president of the Tri-State of St. Paul, at the annual meeting of the Pennsylvania State Telephone and Traffic Association. The Robinson address was the high-light of a convention and operators' conference attended by more than 300 of the state's telephone men and women. Mr. Robinson pointed out the evils of over-capitalization among the greatest of which was the necessity of earning an almost impossible rate or eventual ruination of the property.

Small telephone companies were given a thorough consideration in the general session devoted to their problems and lively discussion took place on the dividend-earning possibilities of these plants.

Another of the general sessions was devoted to radio-telephone programs. At this session Wm. S. Paca, manager of the Petroleum Telephone Co., Oil City, told of his company's operations and others related their experiences with program service. President MacKinnon of the national Independent association, continued his helpful state convention program with reference to the U. S. I. T. A. work in getting the Interstate Commerce commission order on depreciation so it will be most acceptable and helpful to the telephone companies.

The feature of the association's annual banquet was the singing of Miss Louise Baer, daughter of the well known Pennsylvania telephone executive, Cameron Baer. Miss Baer came from New York, where she is singing as a member of the "Countess Maitza" company, to appear at the telephone affair.

"WAY BACK WHEN" WITH THE INTERSTATE.

Once upon a time, or to be more exact, over twenty years ago a well dressed, very pleasant young man, behind a flashy livery team, stopped at a farm between Moscow and Troy, Idaho, and immediately started to make friends with the sunburned kid and the shepherd dog that met him at the gate. They proceeded to the house where this polished gentleman introduced himself as a representative of a telephone company—a concern that was later spoken of as The Interstate Company.

This man proved to be a salesman of ability and proceeded to "do his stuff." The lady was highly complimented upon the appearance of her house and she was told that she had an especially bright looking boy. He displayed considerable interest in the progress that the boy had made in school, etc. (That sure was a fine man). Incidentally, he mentioned the many pleasures and benefits that might be derived from the use of the telephone and in the minds of his audience he planted deeply the desire to possess this wonderful luxury, which, only people living in town had been able to indulge in.

This benevolent gentleman went so far as to express the belief that a line might be constructed from Moscow to Troy and that he would do everything in his power to secure a telephone for this "lovely farm house," as well as for the neighbors. The only things he would ask would be for each one to purchase the instrument and pay a small yearly fee of about $12.00 to help cover the cost of operation. This yearly fee would no doubt be more than covered by the dividends derived from the shares of stock that each one would be required to buy, and since everybody would want telephones it would be advisable to take several shares at $25.00 per, talk it up among the neighbors and then set back and enjoy the dividends.

It came to pass that a few weeks later a crew (small) of men began digging holes (shallow), setting poles (far apart) and stringing wire (one). The sunburned farmer kid followed this crew from early dawn until they ceased work at night and marvelled at the lineman (one) as he perched on the top of those big poles (4 inch twenties), while attaching the the wire to the small knob.

A few years later, 1908, that farmer kid became the official night operator for the Interstate Company in their magnificent central office, containing a one-position Magneto switchboard, at Moscow. The toll lines connected to this Exchange ran to Genesee, Pullman, Miola, Palouse, Troy, Kendrick, and Avon or Deary and these same lines also served the farmer subscribers along the way.

There was no need for a rate operator and there was no confusion about toll tariff schedules or anything of that sort as the only rate charged was twenty-five cents for an unlimited conversation between any two exchanges. A "single ticket" method was used and PS tickets were impaled on a spindle when the cash was placed in the cigar box. If it became necessary for the Manager or his office employees to make purchases of batteries, wire, pencils, stationery, candy, ice cream or other office necessities, the then prescribed routine to follow was to make a "transfer" of a PS ticket from the spindle to the stove and remove the necessary "two-bits" from the cigar box.

The old Interstate Company pioneered in the development of the telephone business throughout the farming communities of the Palouse country, but because of strong competition and high promotion costs it became necessary to withdraw from part of its territory in order to properly safeguard the rest of its properties.

The remains of the old Interstate Company were finally taken over by competing concerns that had maintained a better check on their cigar boxes, but a few of the old instruments may yet be found in the farmers' houses and some of the locally owned lines are still using part of the original Interstate poles.

So the "farmer kid" went out into the world and eventually it came about that he returned to find a stepmother The Interstate Utilities Company, but as is the case with some step mothers, he is denied the privilege of getting his candy, ice cream, etc., in the manner that he did in the good old days. —C. E. Johnson in Interstate Relay.

Issue $2,150,000 Bonds on United Telephone

Chicago, Ill.—Paul C. Dodge & Co., Inc., Wm. L. Ross & Co., Inc., and Whitaker & Co. have issued $2,150,000 first mortgage gold bonds on the United Telephone Co., divided $1,400,000 series "A," and $750,000 series "B." The company's operations are supervised by J. G. Wray & Co. and consist of plants in Michigan, Ohio, Iowa, Indiana, Minnesota and Texas.

Matthews Elects Five Directors for Year

St. Louis, Mo.—W. N. Matthews Corp. has elected as directors to serve for one year W. N. Matthews, Claude Matthews, M. C. Cooley, Frank Y. Gladney and A. C. Carpenter.

Guymon, Okla.—T. A. Singer, of Memphis, Tex., has purchased the Guymon and Hansford Telephone Co. from E. Johnson.

Fitzgerald, Ga.—Bowen Telephone Co. has bought plants at Sycamore, Ashburn and Rebecca from R. Huckabee.

Ohio's Meeting

(*Continued from page 32*)

tween you and assaults made upon your industry.

"(2) It is the rudder that steers your ship through uncharted seas to a harbor of safety.

"(3) It is a source of information and advice.

"(4) It is a guide post that points to the right direction.

"(5) It is a garden that furnishes you food for thought.

"(6) It is a builder of character and a teacher of self-reliance.

"(7) It is a haven for the disconsolate.

"(8) It is a stabilizer for your business, and a certificate of membership in your association is an emblem of cooperation which is so necessary to a successful business career."

In his brief remarks on "Utility Taxation and Uniform Rule" State Senator Allen G. Aigler said that until the uniform rule is abolished there is a good chance of utility taxes going higher.

Wired Radio Is Featured

Two interesting addresses were made on wire radio. Frederick Frankel of Cleveland, general counsel of the Ohio Cities Telephone Co., related the plans of one of the large electric light and power holding companies to supply a choice of three programs by simultaneous carrier waves, with static and distortion eliminated. Minimum rate is said to be fixed at $2 a month, with a maximum not yet fixed. The program planned is to be diversified in an interesting manner and several big features are reported to be under contract. This company estimates that during the first five years of operation it will have the following sets installed; first year, 150,000; second year, 600,000; third year, 1,500,000; fourth year 2,291,000; fifth year, 3,083,000. Following this address J. O. Campbell talked on "The Physical Side of Wired Radio" and advised telephone companies to get after this program business at once or have the field pre-empted by power and light companies. He spoke of the results of the 180 loudspeakers in service at Norwalk, citing the need of regulation of tone balance and keeping circuit balanced when speakers are on and off the circuit as two pressing technical problems.

Harry Hyatt, Cleveland, told of the work the Ohio Bell has done since 1923 in tree trimming, and how failure to have the work done properly by owners resulted in educating company employes and other interested parties in proper trimming methods.

C. W. Kugelman, Portsmouth, gave a very practical outline of estimating future demands for service and handling them. Suggestions for increasing extension telephone service and revenue were advanced by W. G. Barry of Cleveland in the concluding session.

The traffic conference was in charge of R. F. Pagels, traffic manager of the Warren and Niles Telephone Co.

International T. & T. Is Big Foreign Factor

The International Telephone and Telegraph Corporation was incorporated June 16, 1920, to carry on general telephone, telegraph, cable and wireless business and businesses incidental thereto, including the construction and operation of such communicative systems and the manufacture and distribution of electrical equipment in the states and territories of the United States and specifically to transact such business in Cuba, Porto Rica and other islands of the West Indies, Mexico, Central America, South America and Europe as well as in any other foreign countries.

The International owns 97 per cent of the common stock of the Cuban Telephone Company and over 97 per cent of the common stock of the Porto Rico Telephone Company. Through these companies the International Corporation serves practically the entire 4,800,000 population of Cuba and Porto Rico. The International corporation, through its subsidiary organization, Cuban Telephone Company had in operation in 1926 in Cuba a telephone system rated A with 53,795 telephones connected, 8,784 magneto equipment, 3,509 common battery equipment and 41,502 automatic equipment. In Porto Rico, Porto Rico Telephone Company, operated by International corporation operated 11,986 stations, magneto and common battery equipment, as reported in 1926.

Cable Company Holdings

In addition the International corporation owns jointly with The American T. & T. Company all of the stock of the Cuban American T. & T. Company; forming the connecting link by telephone cable between the Island of Cuba and the telephone systems of the United States. The Cuban American T. & T. Company owns and operates three submarine cables, each slightly over 100 miles in length between Havana and Key West, which have been in operation since April, 1921.

The International corporation also owns a substantial interest in the common stock of the Compania Telefonica Nacional de Espana which was incorporated under the laws of Spain, Apri 19, 1924, and operates under contract with Spanish Government, signed August 25, 1924. This company now owns and operates a telephone system consisting of 390 exchanges, covering over 840 cities and towns, with a total of 102,000 stations. It has about 8,000 employes.

In 1925, International T. & T. Corporation announced that it had arranged to acquire a controlling interest in Mexican T. & T. Co., which was incorporated Feb. 21, 1905, to construct and operate telephone, telegraph and electrical plants, lines and systems in Mexico. Under the new management, negotiations were concluded for the return to the company of its property which had been in the hands of the Mexican government since 1914. An amended concession was secured covering the right to construct and operate a telephone system in the Federal District (Mexico City and its environs), as well as valuable concessions, covering the right to construct and operate a long distance system throughout and local systems elsewhere. These concessions are sufficiently flexible in their provisions to enable the company to develop its properties under favorable conditions. Plans for the physical rehabilitation of the company's plant provide for the reconstruction and modernizing of central office equipment and outside construction in the cities of Mexico hereinafter named and for the construction of long distance telephone lines, between Mexico City and intervening points to Laredo on the American border. Laredo is situated about 125 miles south of San Antonio, Texas, the metropolis of the state, with population of over 200,000. Laredo is the southern terminus of the International & Great Northern Railroad and San Antonio is on the main line of this R. R. Nuevo (New) Laredo is the northern terminus of the National Railroad of Mexico.

Before the end of this year the long-distance circuits of the Mexican T. & T. Company will connect Mexico City, population 65,000; Queretaro, population 30,000; San Louis Potosi, population 57,000; Tampico, present population estimated at 100,000; Ciudad Victoria, popuation 17,000; Saltello, population 47,000; Monterry, population 90,000, and Nueva Laredo, population 15,000 (all of these communities are served by the National R. R. of Mexico) and connections will be made with Laredo, Texas, and then international connections will be made. At present, circuits connecting Mexico City and Quereto, 154 miles distance, are in operation. Before the end of the present year these lines are to be extended to Nueva Laredo situated west side of the Rio Grande and connection established with the Laredo, located on the river opposite Nueva Laredo.

Klemme, Ia.—A. G. Koerner, owner of the Koerner Telephone Co., has sold the business to N. G. Clark of Mason, Ia.

Manson, Ia.—Central Mutual Telephone Co. has bought Long Bldg., to which its local office will be moved.